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ELECTRICAL WORLD AND ENGINEER.

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UNION ENGINEERING BUILDING.

An idea that for twenty years past has haunted many minds as noble and altogether desirable has at last been brought into the realm of possibility and reality by the generous gift of Mr. Andrew Carnegie of one million dollars for a union engineering building in New York City to be shared on appropriate bases of equal partnership by the four great national engineering societies, the Engineers' Club, and kindred engineering bodies to whom a meeting place and a home can also be offered, under the unrestricted and unconditioned offer that has been made. It is a fact that deserves to be put on record here that not only has the American Institute of Electrical Engineers embodied in its transactions for many years its desire and efforts to bring about such a consummation, but that the chairman of the Institute Library Committee has a letter in which, after having submitted the idea for his approval in 1895, Mr. Carnegie wrote back in warm approval and commendation of the plan, which thus, eight years later, he is himself the means of rendering feasible of execution. The history of the course of events during the past three months and of the present situation will be found on another page.

This gift of Mr. Carnegie to the societies of which he is a member and representing the professions to which he is glad to acknowledge his indebtedness comes "without strings," but it has, nevertheless, serious obligations. The Engineers' Club has already provided itself with land, but the four engineering bodies named specifically have to deal with a real estate transaction of between five and six hundred thousand dollars. In fact, the necessary steps have already been taken to secure the land, and at this moment the Union Engineering Building is to be regarded as a tangible actuality. When we remember that the societies in question have at least 10,000 members in good standing, the financial responsibility upon them dwindles into insignificance. Even if one or other of them should not feel able or willing to come in, there is all the more left for those which do respond to this clarion call to co-operation.

We can see and imagine many points of difficulty in the plan. We have heard them for nearly a quarter of a century. They are well made. There is nothing fanciful about them. Full and prayerful consideration should be given to them. In no particular will any society be urged to surrender its autonomy or self-respect. But it is always easier to find reasons for grimly standing apart than to hit upon methods of harmonious union; and just now the men in each body who believe that civilization itself is based on "getting together" for the common good have their opportunity to benefit the profession to which they belong by making the most of the situation. Possibly some time in the future each society in interest may have an individual golden chance not yet accorded to the others, but we do not hesitate to say that if this generous proposal is spurned it will be a long, long time before the next comes from anybody else.

Whatever may happen, we cannot refrain from noting how events lead on to each other. The gift by Dr. Wheeler of a unique library to the Institute forced the issue of a permanent home for that body now growing at an unparalleled rate. The foundation of the John Fritz medal next brought all the societies together as never before, and revealed their splendid strength when working in union. The presence of Mr. Carnegie at the Institute Library dinner this year was the fact bringing together these and other precedent conditions; and out of it all emerges this building endowed as such a building

never was before. We subscribe humbly to Lord Kelvin's conception of Providence expressed last week and submit this confirmation to his notice.

The New York Electrical Society.

Few things have given more satisfaction to all concerned in electrical matters in New York City than the continuing activity and growing prosperity of the New York Electrical Society. It might well have been supposed that the extraordinary advances made by the American Institute of Electrical Engineers during the past year would have absorbed the energies of most men taking an active interest in the technical welfare of the profession and industry, and that other bodies might have suffered; but, on the contrary, the society appears to have been stimulated, for it certainly has never seen a year of better work, whether in regard to excellent additions to its membership or in the high quality of the meetings and the crowded attendance. In spite of the rigorous persistence with which the society cuts off from its membership list all "dead wood," the growth in numbers is maintained, and is an indication of the fact that at no distant date the society may well expect to attain a thousand members. Its record has been so conspicuously good that inquiries have reached it from all parts of the Union as to its methods and principles; and while the creation of Institute chapters in different parts of the country may obviate the necessity for the creation of local bodies of the New York society type, there is no doubt that this organization, with its popular but thoroughly practical programmes reaching a great many people who would never otherwise come into active touch with the technical leaders and deeper technical questions of the profession, will long find a large sphere of usefulness.

It is for this reason that we may express the hope that the society will not make the mistake of fixing in its constitution the plan which recently has been abandoned by the Institute of electing a president for more than one year. It would be curious now if the society should take this retrograde step just when the Institute has also put into its constitution the one-year idea; but after the obviously strong manifestation of sentiment on the subject last Wednesday night, we hardly think it is likely that the plan will be brought forward again. It is a good deal better that there should be frequent rotation in office with numerous good men available, and especially in a body where so many new and younger men want to win their spurs.

At the same time, we think it is a pity that the plan of giving the nominating committee a broader base could not be carried out, for so long as the nominating committee is in the hands of the executive committee, there is more or less tendency toward self-perpetuation of the body in power. The idea of enlisting the counsels of past presidents is an excellent one, although even that may be overdone. Unless we are mistaken, at one time all the past presidents of the Mechanical Engineers were *de facto* members of the council, but we believe that now this is limited to the last five. While the presence of a large number of past presidents must undoubtedly exercise a somewhat chilling effect upon the exuberance and enthusiasm of the new men when they come into office, it seems likely that a nominating committee embracing one or two of them would be all the better qualified for its important and delicate task.

The Debate on Central Stations.

Rarely has any meeting of the Institute been productive of more vigorous discussion than the last. The topics discussed were of direct and active interest to many of the members, and the papers were sufficiently suggestive to stir up active debate. On the whole, the discussion, which is printed elsewhere in this issue, added considerable interesting information to the papers and yet after carefully reading it over, it seems to us that many of the really vital points were passed by in favor of relatively unimportant details. Still, the steam turbine which is far from an unimportant topic, came in for a liberal amount of attention, and the point was brought out that the economy of the reciprocating engine can be brought by multiple expansion and superheating to a point considerably beyond anything that has been claimed for the turbine. One feature of the comparison, however, escaped attention—that the steam pressure in a reciprocating engine can be raised, and the superheating forced until further advance is blocked by the failure of lubrication, while with the steam turbine the pressure cannot be pushed without increasing a peripheral speed, already inconveniently high, nearer and nearer to the danger limit set by the strength of the materials, and the advantage of superheating fails. The strongest point of the steam turbine is the high economy at low load, which results from the small frictional losses; and the gain in compactness that comes with high speed of both turbine and generator.

The mooted point of one central station of enormous size versus several smaller ones came in for plenty of attention, but the discussion was far from illuminating, being largely a reiteration of old arguments pro and con without eliciting any important practical data. As we indicated last week, the vital point in this comparison is not the cost of power on the bus-bars, but its cost delivered at the center of distribution. It makes little practical difference at what size of station the production cost of power reaches a final uniformity, for the real question is whether this final result can be reasonably expected ever to reach a figure great enough to compensate for the losses in the transmission and reconversion between the station and the center of distribution. So long as three or four conversions lie between the one point and the other, the single station must show a very considerable economy in generation to justify its existence, and the really important thing is to find out whether this economy actually exists to the required extent. We know of no data which have been made public, covering this phase of the case. Instead of direct statements of cost per kilowatt-hour *delivered,* including proper interest and depreciation charges on the high-tension lines and transformers, the rotaries and their stations, and the batteries which Mr. Lieb pertinently remarked were quite indispensable, we have eulogiums on the great advantages of modern methods of power transmission from consolidated central stations of great efficiency. One of these advantages we think has received far too little attention. We refer to the desirability of putting the whole generating plant well outside of the city. If the lighting and power generation could be carried on, say, 10 miles from the urban center, it would be easy to bring so great a popular pressure on burners of coal within the city limits as virtually to compel the use of electric power almost universally, to the great gain of the city as well as the electric supply company. If transmission is a good thing, why not work it to its legitimate conclusion?

The Rise of the Technical Graduate.

The change in the status of the technical graduate which has occurred during the last twenty years is one of the most remarkable incidents in the professional and industrial history of the period. Even as recent as ten years ago, a young man entering the electrical field from a technical school found himself a target of contemptuous remarks from the "practical" engineer and the "hard-headed" business man, and not infrequently a victim of malice on the part of his associates of practical training. His theoretical attainments were scoffed at as entirely superfluous in the work-a-day world, and tales of his blunders and inaptitude were spread far and wide by eager

critics, who were legion. In looking back to those days, one can now see that the mistake of the detractors lay in lack of recognition of the intrinsic value of the systematic training of the mind received in the schools, and in rendering judgment on defects incident to the transitory states of youth and lack of experience. Time has brought its revenge, and to-day the graduate absolutely dominates in the electrical profession, and where not already occupying the posts of profit in the administrative and business branches, he is, according to present indications, the only candidate who in the future will be considered.

It might be assumed that the revolution noted could be ascribed to the peculiar circumstances of the electrical field—to abnormal conditions arising from a sudden and enormous development. In point of fact, however, while the value of technical education was first most fully recognized in that field, and the graduate there has most quickly gained the ascendency, similar influences have been active everywhere. In agriculture, for example, we learn from the old and conservative *Rural New Yorker* that the graduate of the agricultural college is coming to the front more and more. In a recent editorial it is stated that in the cultivation of large blocks of land as a business investment, the principal difficulty encountered has been in finding capable managers, and employers have been turning to agricultural colleges for the type of man combining the necessary qualifications of knowledge, skill and tact, with the consequence that the demand for graduates many times exceeds the supply. Commenting upon this condition, our agricultural contemporary says there was a time when practical farmers sneered at the college graduate and had little use for him. "But now the whole aspect of affairs has changed. The colleges are turning out trained and sensible men who, with fair experience, will make excellent managers. Western men have, during the past few years, invested quite extensively in farm lands. Their plan is to throw several farms together and conduct the whole under one management in a business-like way. This has given opportunity for trained men, so that to-day a capable graduate of an agricultural college has a far better business opportunity than the average graduate at a professional school. This, we think, is only an indication of what is coming in the future." Indeed, the world do move!

POLYCYCLIC TRANSMISSION SYSTEMS.

Mr. Bragstad's article on page 786 of this issue revives the subject of composite transmission, to which we referred in the number of last February 28th in connection with the Bedell system. The general plan is the same in both systems. That is to say, there is at the central station a two-phase generator, or group of generators, and also a single-phase generator, or group of generators. The transmission wires are the same in both systems, there being four such wires. So far as the two-phase transmission is concerned, there are two separate pairs of wires or independent two-phase circuits. So far as relates to the single-phase transmission, the active pairs are those which are inactive for the two-phase transmission. Out of four wires, six pairs may be drawn. Two of these pairs carry the two-phase power currents. The remaining four may be regarded as carrying, or as capable of carrying, the single-phase currents. The two systems differ, however, in the details of interconnecting the single-phase and polyphase machines. In one the single-phasers are connected to the centers of the transformers, just as in the usual common battery systems of telephony the direct-current source, or storage-battery, is connected to the circuits at the centers of the induction coils. In the other case the single-phasers are connected to the outside mains. For the full utilization of each system, either step-up transformers or auto transformers at the generating station, appear to be needed.

The advantage of such a composite system of transmission is usually claimed to be a saving in copper by reducing the total conductive drop. It is doubtful, however, whether any marked advantage lies in the direction of economy of copper. As a rule, an equivalent saving of conductor might be made by raising the pressure. Moreover, these systems require four transmission wires, instead of three, the usual number for multiphase transmission. On this account the extra wire with its insulation and erection offsets a considerable part of the conductor economy effected.

It would seem that the real advantage of composite systems lies in the direction of separating the lamps from the motors, so far as concerns the regulation of pressure. There is often much disturbance in the pressure at incandescent lamp terminals owing to the sudden addition or release of a motor load on the system near by, as when, for instance, an alternating-current elevator motor is suddenly started or stopped and incandescent lamps are operated from the same mains. The motors do not need close pressure regulation, but the lamps do call for close regulation, and in order to maintain the lamp regulation under variations of motor load, more copper has to be invested in the mains than would otherwise be necessary; or, if smaller and fewer motors are connected to the mains, than would be admitted, if the lamps were independent. By connecting the lamps to the single-phase part, and the motors to the polyphase part of a composite system, it is theoretically possible to let the motors tear their pressure regulation to shreds, and yet to maintain the single-phase pressure at incandescent lamp terminals as closely as though the motors were entirely disconnected from the system.

RONTGEN RAYS AND OTHERS.

A recent discovery which is of very great interest seems so far to have attracted less than its due share of attention. We refer to the discovery by M. Blondlot of an entirely new set of radiations derived from an ordinary focus tube and capable of penetrating thin wood, paper, aluminum foil and the like. The striking feature of the new-comers is the fact that while possessing a fair amount of penetrative power they are unmistakably to be classified with ordinary light, and yet do not affect the photographic plate. They can, however, be reflected and refracted, are in themselves plane polarized, but can be given elliptic polarization or rotary polarization by the usual means, and can be brought to a focus by a lens and be deviated by a prism. M. Blondlot, using a tiny spark for an indicator, demonstrated all these properties and finally obtained a rough measure of the index of refraction through a quartz prism. It proved to be in the neighborhood of 2.0, although the radiation evidently covered quite a range of refrangibility. This would indicate that the Blondlot rays, as they deserve to be called, are allied to the extreme ultra-violet rays of the known spectrum. Ordinary metallic spectra rarely show anything beyond a wave length of about 200 $\mu\mu$. By putting source and apparatus in vacuo, wave lengths down to about 100 $\mu\mu$ have been found by photography, but beyond this atmospheric absorption or failure of the photographic plates has blocked further progress. Now from the index of refraction observed Blondlot's rays are likely to be very much shorter in wave length even than 100 $\mu\mu$, so that at first glance the discovery would look as if we had passed beyond a great atmospheric absorption band and reached a new region one step nearer to the debatable ground held by other mysterious radiations. Each year we are getting material for the study of generalized radiation in place of our previous fragmentary knowledge, and sooner or later the time will be ripe for a general clearing up of the subject. Just now we are fumbling around rather in the dark and making very hard work of things that will probably turn out to be simple.

One Million Dollars for a Union Engineering Building.

During the present week a pamphlet has been issued to the officials of the four national engineering societies and of the Engineers' Club, as well as to the daily and technical press, detailing the manner in which Mr. Andrew Carnegie has, unsolicited and without conditions of any kind, placed at the disposal of the societies and the club the sum of $1,000,000 for a Union Engineering Building. It will be remembered that after giving a sum of several thousand dollars to the library fund of the American Institute of Electrical Engineers, Mr. Carnegie was the guest of honor at the "Library" annual dinner, where he had an enthusiastic welcome and spoke most eloquently on the American characteristic spirit of co-operation as evidenced in enginering work, and bodies such as he addressed.

Next day he sent for President Scott and Mr. Calvin W. Rice, chairman of the Institute Building Committee, and they report what occurred as follows:

"At the interview Mr. Carnegie stated that he had enjoyed the annual dinner of the American Institute of Electrical Engineers the evening before in celebration of the founding of its library. He said that he had been interested in what had been said about the work of electrical and other engineers, and also in the suggestion of a common building for the various societies. He asked many questions concerning the status, the building and the income of the several organizations. We spoke of the present project of the Engineers' Club for a building on Fortieth Street.

"Mr. Carnegie asked what plans, or definite suggestions, we had in mind. We replied that so far the scheme of an Engineering building had been discussed by individuals, but that no official or concerted action had been taken. We could simply outline a policy—not a specific plan. We said that our ideas would be met by an adequate building on Fortieth Street to accommodate the National Engineering Societies, to provide headquarters and meeting places for other engineering bodies and to provide for the Engineers' Club. Each body should have such individual rooms as would meet its requirements, and there should be suitable assembly halls and the like, to be used in common. The placing of the technical libraries of the several societies in one building, near the new public library, appealed to Mr. Carnegie.

"He wanted us to ascertain what the land would cost; but, later, when we had indicated about what the societies are paying in rent, and the value of the property held by some of them, he said: 'Why, you are able to support a building if you had one'; and a little later he said: 'Why, if you can provide the ground I will put up the building.'

"Mr. Carnegie asked that we take up the matter confidentially with others interested, and that we call again with a few other gentlemen as soon as we have a plan to submit."

The upshot was that on February 14 Mr. Carnegie, in a letter, directed to the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, and the Engineers' Club, said: "It will give me great pleasure to give, say, $1,000,000 to erect a suitable union building for you all, as the same may be needed."

On April 30 the following met at dinner at the Engineers' Club on behalf of the informal committee and the various bodies: Messrs. John Fritz, John C. Kafer, Alfred Noble, J. M. Dodge. C. F. Scott, G. E. Weed, B. B. Lawrence, E. E. Olcott, Calvin W. Rice, T. C. Martin, W. A. Redding, John Thomson. On this occasion statements were made by Messrs. Scott and Redding and the subject discussed thoroughly. The various presidents promised to communicate with the councils of the different bodies; and it was arranged to meet again at the house of the Civil Engineers on May 7 at 8:30 P. M. In the mean time, the sum of $50,000 has been paid out for options on five contiguous properties on West Thirty-ninth Street, on the north side, giving a frontage of 125 ft. and a depth of nearly 100 ft. as a site suitable to be occupied by the four societies, or such others as may be determined on. This property is immediately south of the real estate on West Fortieth Street, acquired for the Engineers' Club already, so that the proposed united building, for all the purposes contemplated, will have an ideal location and frontages at what will long be the heart of New York City, and the most accessible spot on the island.

A plan of co-operation has been drawn up, on legal lines, by Mr. W. A. Redding, the well-known patent lawyer, speaking on behalf of the Engineers' Club, and suggesting how the different bodies, while retaining full and absolute independence, can join forces and avail themselves of this opportunity. Mr. John Fritz contributes an admirable letter heartily endorsing the plan, for which he has already done so much, and in the course of which he says: "No one society of engineers can claim that its members did it all; for it has all been accomplished by their united efforts. I most ardently hope they may still become more closely associated, both on social and on engineering lines. The societies are so interdependent and overlap each other to such an extent, that to me it is most surprisingly strange that the efforts which have been made before this time to bring them in closer contact with each other, have not been successful."

Mr. Redding, in his draft of one plan by which the character and arrangement of the buildings should be determined, says:

There should be a joint committee, composed of the president and two other members of each of the organizations that shall unite in accepting the gift of $1,000,000 from Andrew Carnegie, and this joint committee should have power to determine by the affirmative vote of at least two-thirds of all the members thereof the character and arrangement of the buildings to be erected on the site on Thirty-ninth Street and on the site on Fortieth Street; and should also have power to obtain from competent architects plans and specifications for the erection of such buildings, and to approve by the affirmative vote of at least two-thirds of all the members thereof of the plans and specifications for the erection of such buildings; and should also have power to make and enter into such contract as shall be approved and authorized by the affirmative vote of at least two-thirds of all the members of such committee for the erection of such buildings.

The vesting in such joint committee of these powers would avoid great diversity of opinion and much controversy that would arise if these matters should have to be submitted to each organization for approval.

The building to be erected on the site on Fortieth Street should, of course, be occupied exclusively by the Engineers' Club. The joint committee above suggested should have power to determine by the affirmative vote of at least two-thirds of all the members thereof what portion of the building to be erected on the site on Thirty-ninth Street should be occupied by each of the four national societies of engineers above named that shall unite in accepting the gift of $1,000,000 from Andrew Carnegie, and what portions of that building should be reserved for the occupancy by other societies of engineers that shall be permitted to locate therein.

This joint committee should also have power to determine by the affirmative vote of at least two-thirds of all the members thereof what societies of engineers, other than the four national societies of engineers above named, should be permitted to occupy portions of the building to be erected on the site on Thirty-ninth Street.

Mr. C. F. Scott furnishes to the pamphlet an excellent letter going into many details of the proposed plan. The following points will be of great interest:

The four general engineering societies named by Mr. Carnegie are but a part of the engineering societies which are to be benefited by a union engineering building. There are numerous societies, many of them strong and vigorous, whose membership contains many of the members of the general societies, but whose fields of activity are specialized in their scope. The work of these societies is of a high order, and taken in the aggregate it is a most important part of American engineering. Definite permanent headquarters and accommodations in the same building with those of other societies will be advantageous to the societies themselves, and will be of great convenience to their members.

Some of the uses and advantages of a union engineering building may be indicated in a general way without entering upon details.

A large assembly hall will be available for lectures and for the holding of general conventions of engineering societies.

A number of smaller halls will accommodate smaller audiences and will be suitable for monthly meetings of societies and for sectional or supplemental meetings at the time of conventions.

The libraries of the several engineering societies placed in adjacent alcoves or rooms will constitute a magnificent engineering library. Economies will be effected as many books need not be duplicated which would be necessary if the libraries were separate, and there may be reduced cost for administration. The several libraries may have a common index. Moreover, the Union Engineering Library will be adjacent to the new building of the New York Public Library, Fortieth and Forty-second Streets. Rooms may be available for reading and writing. The building itself may become a gallery of portraits of eminent engineers and illustrations of engineering works.

Accommodations for the administrative offices of the several engineering societies may be arranged to suit their various needs. Facilities for the officers, boards of direction, committees, as well as for the mailing, and possibly the printing, of transactions may be afforded.

Facilities may be arranged for the serving of luncheons or dinners at the time of conventions or meetings and for the holding of formal dinners and banquets. A common cuisine may serve the Engineers' Club and the engineering societies.

The present Building Committee of the American Institute of Electrical Engineers includes Messrs. Calvin W. Rice, S. S. Wheeler, C. O. Mailloux, W. D. Weaver and T. C. Martin, and it has already considered the scheme and reported favorably to the council on the subject. President Scott will doubtless have important announcements to make in regard to the matter at the annual meeting next week, May 19.

Electrical Equipment of a 24-Story Bank Building, Pittsburg.

A GREAT twenty-four-story office building recently erected in Pittsburg—that of the Farmers' Deposit National Bank—is notable for the many new features introduced in its electrical equipment. The alternating current is used throughout and all illumination is furnished by Nernst lamps.

The electric plant consists of four generating sets, one of 75 kw, and three of 150-kw capacity. The 75-kw unit is driven by a 120-hp, single-cylinder, enclosed-type center-crank engine, running at 277 r.p.m., and the remaining generators by three center-crank tandem-compound engines of 240-hp, running 240 r.p.m., all engines having been supplied by the Phœnix Iron Works Company, Meadville, Pa. Steam at 125 lbs. is delivered from a battery of four Babcock & Wilcox boilers of 300 hp each, fitted with Babcock & Wilcox chain-grate stokers. The generators are Westinghouse composite-wound, two-phase machines of a frequency of 60 cycles per second and a voltage of 225. The frequency of the 75-kw machine is the same as that of the 150-kw machines, so that although running at different speeds all four may be operated in parallel. The separate excitation of each machine is by a dynamo mounted at the end of the main shaft. The capacity of the separate exciters is 4.4 kw for the larger size and 3.1 for the smaller. A series transformer in the armature spider produces a secondary current of low voltage, which is rectified by a commutator on the shaft, and excites the series windings of the alternator field.

The switchboard, built by the Walker Electric Company, is over 43 ft. long and is made up of 17 panels; 4 of these are the generator panels, 1 panel for the power circuits, 11 for the lighting circuits and one is spare for additional light and power switches. Four bus-bars are provided for power distribution and six for light. The light switches are triple-pole, a three-wire system being in use for lighting with a Westinghouse balancing coil or phase-splitter of 20-kw capacity installed in each phase, so that a voltage of 110 is obtained between the middle bus and each outside conductor, and they are also double-throw, so that the light load may be distributed on either phase. These balancing coils are mounted on the wall back of the switchboard, as are also the rheostats for exciters and generators. The board is furnished with Noark fuses mounted on the front, I. T. E. circuit-breakers and Keystone instruments.

From behind the switchboard the feeds run to three main risers and distribute up through the building. These risers have pull boxes on the sixth, twelfth and eighteenth floors, where the feeds may be tied in, in cases where they do not terminate. There are panel boards at each riser on each floor, and on these panel boards are three sets of bus-bars fed by different feeders. These three sets of busses are intended for the lights in the offices, the regular hall lights and the special hall lights or night circuit. All main switches to the panels are triple-pole, and the busses, which extend horizontally across the board, are secured in place by removable screw connections to the main vertical bus-bars. This arrangement allows the changing of any branch circuit from 110 to 220 volts by means of these movable connections.

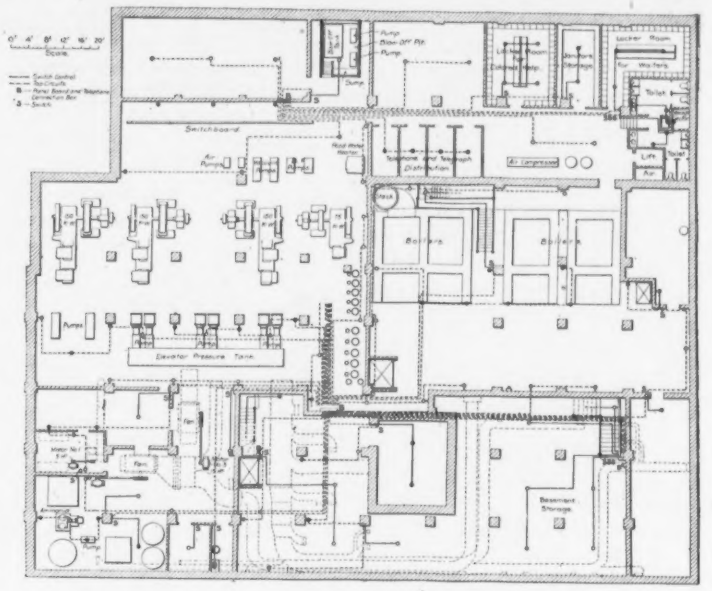


FIG. 2.—PLAN OF BASEMENT.

The Nernst Lamp company is supplying lamps for the halls and offices at 225 volts. Two 110-volt circuits are run to small tablet boards in each office. In cases where so desired, these circuits may be continued from the tablet boards by means of the chair rail to locations where desk lights are needed. These lights are the only cases where other than Nernst lamps are likely to be used. There are installed 1,000 55-kw. single-glower; 1,250 88-kw. single-glower; 20 two-glower and 20 six-glower Nernst lamps in the building. The halls are finished in green, with white marble trimmings, which illuminated by the soft steady light of the Nernst lamps have a most pleasing effect. The office trimmings are of mahogany, and the offices are in general attractiveness and beauty especially noteworthy.

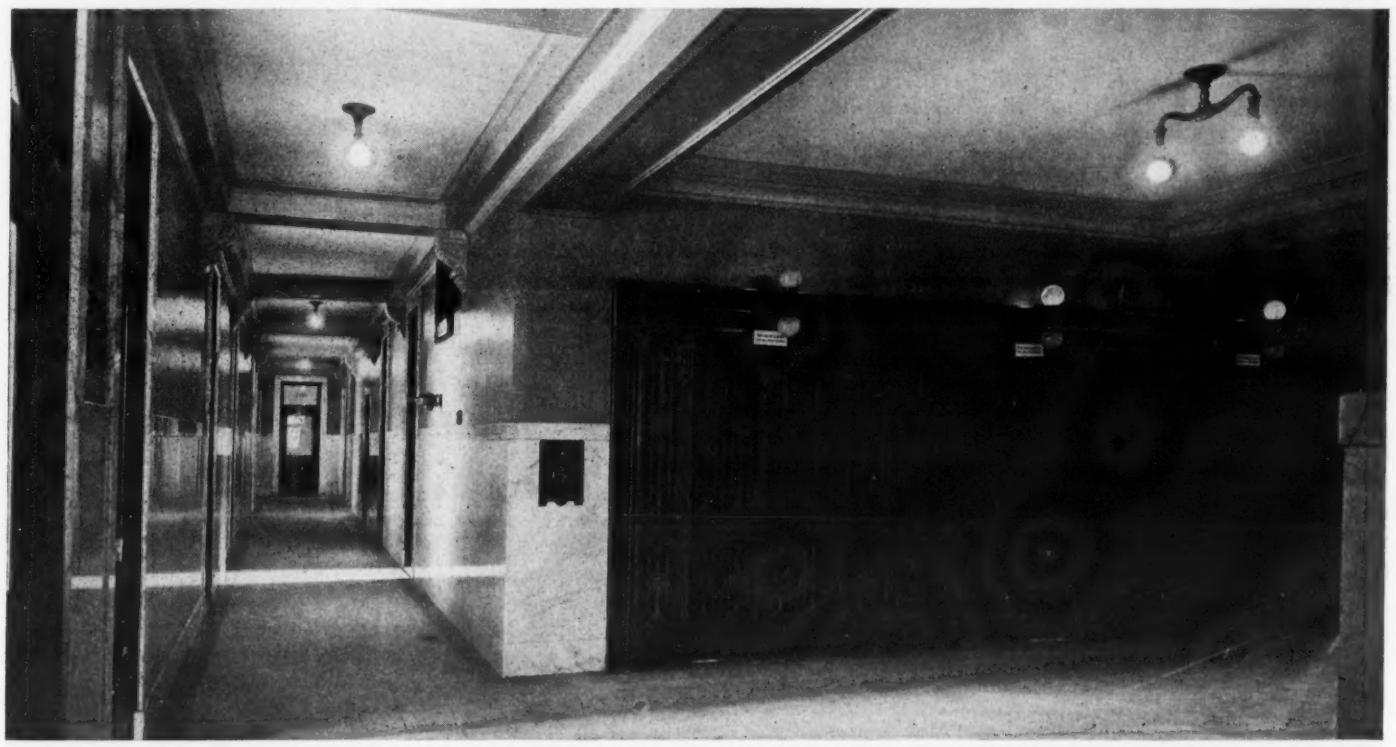


FIG. 1.—VIEW OF A CORRIDOR ILLUMINATED BY NERNST LAMPS.

A peculiarity of the Pittsburg regulations respecting the electric wiring of buildings is that switches must be provided on all lighting circuits, not more than four lights, under the control of one switch. The use of smaller than No. 12 wire is prohibited.

There are installed in the building seven induction motors aggregating about 75 hp. In the attic are three-disk exhaust fans of 7, 5 and 3½ ft. diameter, which are belt-driven from 15, 7½ and 5-hp, two-phase Westinghouse induction motors. In the basement are three motors of the same type; one of 20 hp drives a 7-ft. steel plate fan supplying fresh air to the engine and boiler room, another of 10 hp for a 6-ft. blower supplying tempered air to the banking room, and the third of 5 hp running the filter-cleaning fan.

In addition to ten Otis hydraulic elevators for general passenger service, there are two electric elevators in operation between the bank floors, one as a book lift and the other for passengers. The electric equipment for the electric elevators includes a motor-generator for the control and a 5-hp variable-speed Westinghouse induction motor for each elevator. These elevators are also of Otis manufacture and of the automatic push-button type of control. The absence of direct current in the building has made necessary the employment of a motor-generator in only one other instance, and that is of very small size, for the signal system for the elevators It was thought that the electric winding mechanism in the bank vault, installed by the Hollar Lock Inspection & Guarantee Company of Philadelphia, would require a separate mechanism for supplying direct current; but by running a line back to the main switchboard, the direct current from the exciters at 110 volts was made available for the purpose.

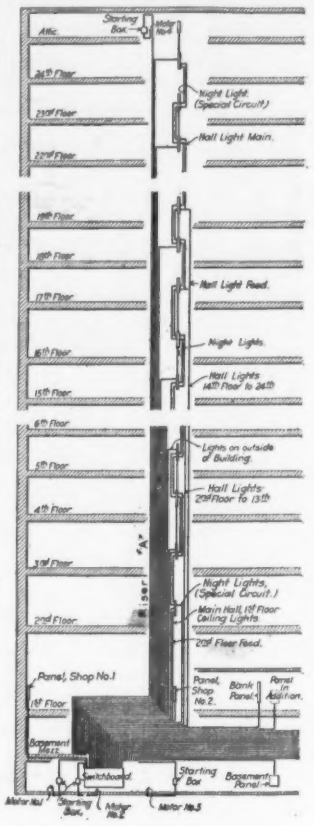


FIG. 3.—DIAGRAM OF FEEDERS.

Above the two revolving doors at the main entrance are two smaller General Electric motors installed by the Van Kannel Revolving Door Company, of New York. As these motors were provided after work had advanced too far to permit of a separate power line, they were placed on the lighting circuits, which was practicable since they have a power factor of 100 per cent., the motors being single-phase with condenser compensator.

The telephone cables on entering the building run along the ceiling of the basement to the terminal booths, where each company is

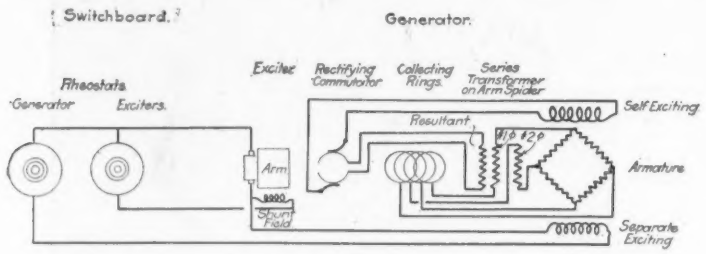


FIG. 4.—DIAGRAM OF GENERATOR CONNECTIONS.

assigned its space, there being in Pittsburg two telephone companies, two telegraph companies, one ticker company and the Electric Protective Company to be provided for. On leaving the booths the cables run up the riser situated back of the elevator shaft and terminate at boards in the halls on each floor. From these floor terminals a one-inch conduit is run to each of the office sub-tablet boards already mentioned in connection with desk lights. A portion of the space in the boxes where these sub-tablet boards are placed is divided off and provided with terminals for eight pairs of telephone wires. From these boxes through either the chair rail moulding or around the baseboard the connection is made to the instruments.

After the plans were drawn for the main building and work well under way a 40-ft. addition was decided upon on the Fifth Avenue front. To provide for this annex the generators were ordered of larger capacity and feeders increased in proportion. This addition is now completed to the height of the original structure, but the interior is still in the rough.

Messrs. Clark & MacMullen, of New York, are the electrical engineers for the work, which has been installed under direction of their Pittsburg office by Messrs. Hatzel & Buehler, of New York.

The Arnold-Bragstad-La Cour Polycylic Power-Transmission System.

BY O. S. BRAGSTAD.

ELECTRICAL power-transmission systems are generally compared with one another with respect to their relative copper outlay under the assumption of equal losses with the same voltage between the wires and the same transmitted power. In this way the copper outlay with the three-phase system is found to be equal to 75 per cent. of that with the single or two-phase systems (the latter assumed to be with four wires).

For the distribution leads in which the insulation plays no great part, the two-phase system possesses the advantage that the load (lamps) has only to be distributed between two divisions and not three, as with the three-phase system. The load is, therefore, more easily uniformly distributed with the two-phase system, and the installations are, therefore, simpler and cheaper than with the three-phase system.

In order to combine both these advantages—saving of copper and simpler balancing—the three-phase system is often employed for the mains and the two-phase system for the distributing leads, the Scott transformer being employed for stepping down the voltage.

In Fig. 1, T_1 and T_2 are the primary windings of two transformers connected, according to the Scott method, with the three-phase system. The two transformers have the same output and carry the same current. The number of windings, T_1 and T_2, are as $\sqrt{3}:1$, 5. Since the currents in the phases 1 and 2 are 30° out of phase with the secondary current of the transformer, T_1, the effective

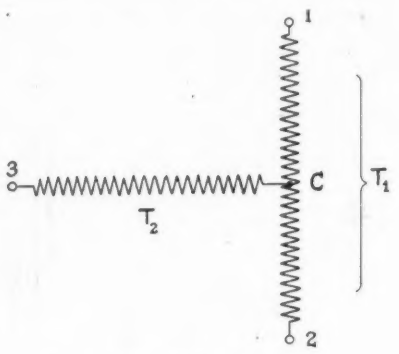


FIG. 1.—DIAGRAM OF WINDINGS.

number of ampere-turns in this phase is only $\cos 30° = 0.865$ of the total number. In consequence of this, the primary copper losses in the transformer, T_1, for equal cross-section of wire—that is, for equal current density in the two transformers—are increased by 13.5 per cent.; the expenditure of copper for the winding, T_1, is further, in spite of the equal output, 13.5 per cent. greater than for the winding, T_2.

It is not only the ohmic losses and the consequent ohmic voltage drops in the three phases which are different, but also the inductive voltage drops. If, for instance, the windings of phases 1 and 2 are separated from one another either on two different cores of the transformer or on two halves of one core, then the current components, $\pm I \sin 30°$, which are not neutralized by the secondary current, produce a very great magnetic leakage. If it is desired to reduce this leakage flux to a minimum, the primary coils of the phases, 1 and 2, must be made only half as large as the secondary coils, and each pair of primary coils (one belonging to phase 1 and the other to phase 2) must be followed by a secondary coil. This renders, however, the use of more insulating material necessary, and the winding takes up more room. Besides the inequality of the ohmic voltage drops in the three phases, there is, thus, always a certain inequality in the inductive voltage drops which, especially

in the case of long transmission mains, can easily become a source of disturbance.

If we examine the matter a little more closely, we find that—at any rate with overhead conductors—the voltage between the wires and the insulating supports, and not that between the wires themselves, must be the governing factor; for upon it depend both the losses in the insulators and the probability of piercing of the same. The insulating supports are, however, more or less well conductively connected with one another and form thus the neutral point of the system. A judgment of the individual systems in respect to their copper demand should, therefore, to be correct, be made on the presumption of equal phase-voltage; phase-voltage to be understood in a one-phase system, as half the voltage between the wires, and in a two-phase system with four wires, similarly half the voltage between two wires of opposite phase.

When we consider the various systems from this standpoint, we find that the three-phase system offers no saving of copper over the other systems; but, rather, that all the systems, inclusive of the single-phase, stand on about the same level. The expenditure for insulating and supporting material increases naturally with the number of phases, as does also the loss through the insulators.

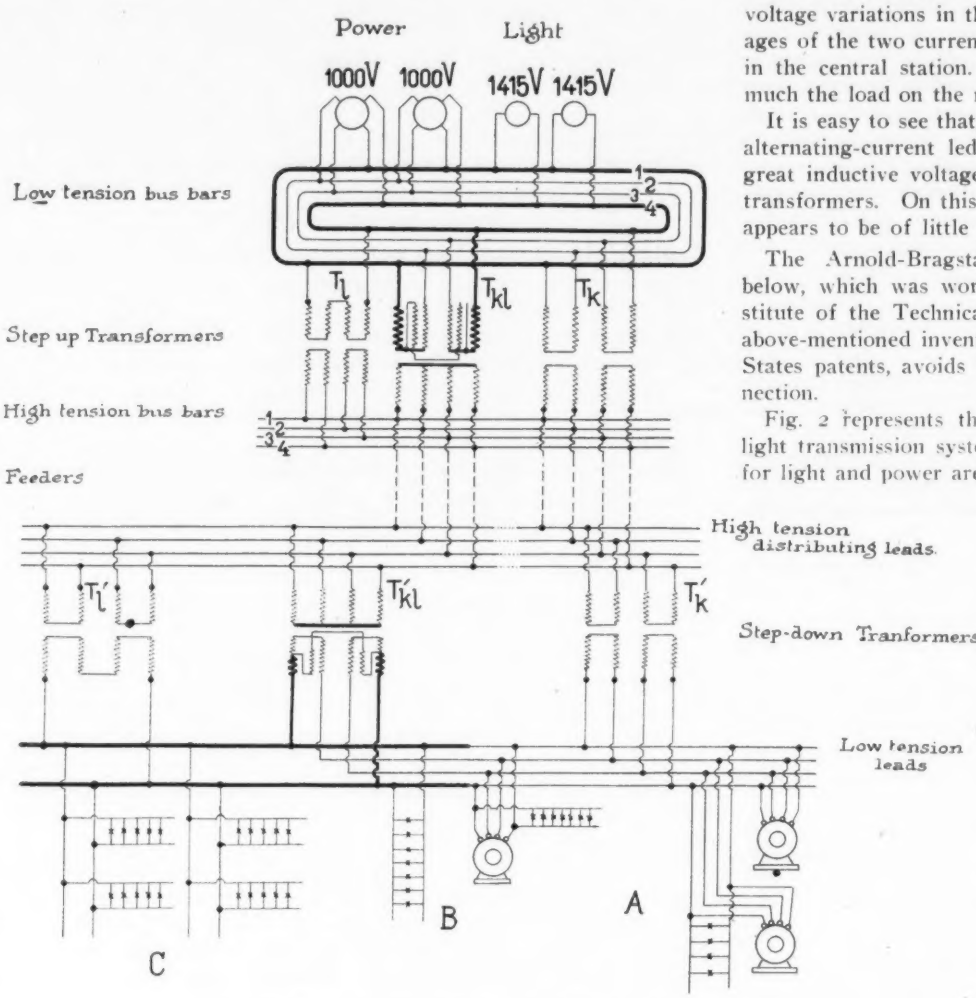


FIG. 2.—DIAGRAM OF CONNECTIONS OF TRANSMISSION SYSTEM.

When the single-phase system cannot, in consideration of the running of motors, be employed, the three-phase system appears thus, in respect to the saving on insulators and fastenings, to be the best. On the other hand, should the necessary size of wire with the three-phase system become so great that it would have to be divided between two parallel-connected wires, then we can, under certain circumstances, use a two-phase system without the necessity of dividing the cross-section between two wires, in which case this latter system requires only four wires as against six with the three-phase system.

American practice often employs, as mentioned above, a transformation from three to two phases, while in Europe the three-phase system is generally retained throughout both for mains and distributing leads. One might, as stated above, in many cases be quite as much justified in employing the two-phase system throughout. To this may be added that, with the two-phase system, other distinctly important advantages can, without essential increase in cost, be obtained, as will be described more fully in the following.

Dr. Frederick Bedell showed first how, at points of equal potential of a power transmission system, currents of various characters, especially continuous current, can be sent in and taken out, without influencing thereby the existing currents, and this discovery has been protected by him in United States patents Nos. 645,907 and 647,741.

The arrangement given by Dr. Bedell was described for a practical case by Mr. A. S. MacAllister in this *Journal*, February 28, 1903. This arrangement permits of a separation of the light and power delivery of an installation, without the necessity of employing special separate systems of leads. In this case single-phase current is used for the lighting and two-phase currents for the power. The voltages, voltage drops and frequencies of the two currents can be chosen as most appropriate for their respective uses; and since the superposed currents are quite independent of one another, variations in the motor current and its phase displacement do not produce any voltage variations in the lighting current, and vice versa. The voltages of the two currents are regulated independently of one another in the central station. A constant light is thus obtained, however much the load on the motors may vary.

It is easy to see that, with the Bedell arrangement, the superposed alternating-current led in at the neutral point must suffer a very great inductive voltage drop in the windings of the generators and transformers. On this account the arrangement in its original form appears to be of little practical use.

The Arnold-Bragstad-La Cour distribution system, described below, which was worked out by them in the Electrotechnical Institute of the Technical College at Karlsruhe independently of the above-mentioned invention, and forms the subject of several United States patents, avoids the drawbacks of the Bedell systems of connection.

Fig. 2 represents the connections of a high-voltage power and light transmission system. In the central station special generators for light and power are installed. The machines for power generate two-phase currents at about 30 periods and 1,000 volts in each phase. The phases are not connected. The generators for lighting are single-phase machines with an e.m.f. of about 1,415 volts and about 60 periods. The generators for power work on all four bus-bars, while those for lighting only work on the outer two (1 and 4). This is possible because the phases, 1 and 2, in the generators for power, are unconnected with the phases, 3 and 4.

The low-voltage bus-bars connected with the generators are connected with the four high-voltage bus-bars through step-up transformers. The high voltage is assumed to be 20,000 volts, and is equal between all four conductors.

For the stepping up of the machine voltage, three kinds of transformers can be used. The one kind, *Tk* serves only for the transformation of the two-phase currents, i. e., for the power consumption, and consists of two ordinary single-phase transformers with a transformation ratio of 1:20, which are connected between phases 1, 2 and 3, 4, respectively. Since these transformers are unconnected, no single-phase current goes through thm. The second kind of transformers, *Tl*, transform only the single-phase current and thus serve only for the lighting. These lighting transformers are also ordinary single-phase transformers and have, like the power transformers, a transformation ratio of 1:20, but the connection of these transformers to the bus-bars is somewhat different.

Each group of the transformers, *Tl*, consists of two single-phase transformers, the primary windings of which are both connected in series between the lighting bus-bars, 1, 4. The secondary winding of the one transformer is connected between the high-tension bus-bars, 1, 4, and that of the second transformer between 2, 3. From the single-phase current of higher frequency, we obtain thus 14,150 volts between each pair of high-tension bus-bars, 1, 4, and 2, 3; since beyond this, between these bars a voltage arising from the

two-phase current of lower frequency and of the same amount exists, we obtain between the same an effective e.m.f. of 20,000 volts. This voltage arising from the two-phase current is the same in both of the series-connected primary windings of the transformers, *Tl*, but the phases are opposite, thus giving rise to no e.m.f. between the low-tension bars, 1 and 4. These transformers take in through their secondary winding a no-load current of the lower frequency and get a corresponding magnetic flux, which superposes itself over the magnetic flux of higher frequency produced by the primary winding.

Since the two kinds of transformers just described are commercial and customary and forms the same type whether they serve for light or power, we can, without further alteration, use the same set of transformers, sometimes for lighting and at other times for power, by simply switching over. The transformers would thus be worked during the day principally for power and in the evening principally for lighting; thereby effecting a saving on the original outlay for transformers.

A third arrangement of the transformers, which permits of the two currents being simultaneously and independently transformed in a single apparatus, appears also very useful. A combined single and two-phase transformer of this kind is shown in the diagram by *Tke*. This transformer has four cores, and while the cores have each one secondary winding, two of them have each one primary winding, and the other two each two primary windings, as indicated in the figure. All the primary and all the secondary coils have an equal number of turns. The advantages of this combination are that it diminishes the necessary active material and increase of efficiency. A disadvantage of the arrangement is that a special construction is demanded, which fact, however, would be of no great importance in the case of a large order.

The mains which go out from the high-tension bus-bars, together with the high-tension distribution leads, consist always of four wires of equal cross-section. These four wires all carry always the same current independently of the relation between the demand for light and power.

The step-down transformers connected to the high-voltage network can, like the transformers of the central station, be made of three kinds. In a quarter of a town, A_1, where almost nothing but motors are connected, transformers for power, *Tk'*, are installed. On the other hand, in that part, B_1 where almost the same number of motors as lamps are to be fed, the combined transformers for light and power come into use. Finally, in the part of the town where residences are mostly to be found and hence only light is needed, the lighting transformers, *Tl'* are employed.

Since a higher e.m.f. is preferably used for motor work than for incandescent lamps, viz., 500 volts as compared with 125 volts, the transformation ratios of the power and lighting transformers are here different; otherwise they are arranged similarly to those at the central station.

The distributing leads for light and power consist of four wires; the lighting current of higher frequency and of an e.m.f. suitable for glow-lamps, is taken from two of them, and from all four the power-current of lower frequency and higher e.m.f.

In those parts of the town where the lighting load is small, for example, at *A*, all the wires of the low-tension network will have the same cross-section; on the other hand, in parts of the town like *B*, where comparatively much lighting is to be done, the two wires which carry both lighting and power current will have a greater cross-section than the other two; lastly, in that part of the town, *C*, where only lighting installations are fed, only the two lighting leads will be laid.

To resume, the principal characteristics of the thus-described system are, briefly, the following:

1. *Machine Installation* separate for light and power, consequently separate speed and voltage regulation, different frequencies, abolition of phase displacement in the lighting machines.

2. *Bus-bar System* in common for lighting and power, hence the simplest arrangement of apparatus.

3. *Step-up Transformers* are either (*a*) separate for lighting and power, but able to be switched over according to need, in which case single-phase transformers of ordinary construction are used; or (*b*) combined for lighting and power, but in such a manner that the two functions do not mutually influence one another. This latter arrangement offers some saving in material, but necessitates a special construction (four-core apparatus).

4. *High-tension Bus-bars* are common, but independent of one another for light and power.

5. *High-tension Mains* are likewise common, but independent for light and power. With equal effective e.m.f., the current-carrying capacity of the wires is increased by 50 per cent. over the single or two-phase systems and by 12.5 per cent. over the three-phase. With respect to the effective e.m.f. to earth, all systems are equal. The same applies to high-tension network.

6. *Step-down Transformers* are, according to requirements of the individual districts to be fed, either only for power, only for lighting or combined.

7. *Distributing System*, according to requirements, either with four wires for light and power or with two wires for light alone. All lighting installations are made in the simplest way, with only two wires; they are, hence, cheaply installed and maintained. Since the voltage variations produced by the motors do not in any way influence the light, motors up to any desired size can be connected; motors with short-circuit armatures (without starters) of much larger sizes than formerly, can be installed.

The advantages enumerated above are, so to speak, obtained without any complication of the lighting systems. If the combined transformers (*Tkl* and *T'kl*), which could equally well be left out, be disregarded, then the diagram (Fig. 2) is not, at first sight, to be distinguished from that of a corresponding two-phase system. The simplification of the lighting installations, as well as of the low-tension network in the parts of the town consuming only light, is obvious.

Multiple versus Independent Operation of Central Stations.

IN the paper with the above title read at the April meeting of the American Institute of Electrical Engineers by Mr. Peter Junkersfeld, after a discussion of some general considerations, the links of a central station system subject to trouble are enumerated as follows:

Main and services. Low-tension feeders. Sub-station apparatus. High-tension transmission lines. Generator, prime mover and auxiliaries. Steam supply. Troubles in wiring or translating devices on consumer's premises are usually more directly under the control of the consumer than of the central station.

These different classes of central station troubles are all more or less liable to occur, but the prevalence of any one class or number of classes of trouble depends upon the character of the different installations, and on local operating conditions. In the discussion of these different classes of trouble the writer would, as a matter of illustration, refer to conditions in Chicago where all 25-cycle, high-potential transmission and direct-current distribution is underground. In the outlying districts the 4-wire, 3-phase, 60-cycle distribution is overhead.

MAINS AND SERVICES.

Formerly Edison tube was principally used for all underground mains. The more recent practice has been to use, largely, cables in conduit giving less trouble than the Edison tube, which is true also of services. However, miles and miles of the old tube mains are in service to-day, and must necessarily remain in service for years to come.

Any trouble, either on mains or services, is usually confined to a comparatively small area by the blowing of strips in the feeder junction boxes. The total amount of current that could be "pumped" into such a short circuit is limited by the drop in mains and feeders, at least back to the sub-station bus-bars. Obviously, the duration of such a short circuit depends on the condition and relative carrying capacity of the "short" and the fuse strips back of it. The drop in mains may be such that it is impossible to deliver enough current to burn off the trouble or blow the fuse strips. These cases, while rare, are very annoying. Sometimes they will "clear" only to start again at an unexpected time, occasionally even making it necessary to remove junction box strips and thus cut out the troublesome section until permanent repairs can be made.

LOW-TENSION FEEDERS.

On account of the larger carrying capacity the energy delivered on short circuit is very much greater in feeders than in mains. The total length of conductor in feeders being much less than in mains, the number of troubles with equally good construction are correspondingly less. Furthermore, instead of tubes, cables have been

very generally used for several years. This improved construction makes the actual number of feeder troubles still less. Serious trouble on feeders, when it does occur, however, obviously affects a much larger area than trouble in mains. The extent of area affected depends also on the arrangement of bus-bars and class of apparatus in station or sub-station.

SUB-STATION APPARATUS.

In sub-stations supplying direct current, rotary-converters with their accompanying step-down transformers and potential regulators, are used almost exclusively. The direct-current ends of these rotary converters are often worked in multiple with an old generating station, at least during the peak hours of one or two months in the early winter. A storage battery with end cell switches for discharging on two or sometimes three different potentials is an important adjunct to a sub-station. The batteries in all sub-stations are discharged simultaneously at time of peak on principal generating station, or in an emergency; at all other times they are allowed to float on system. They are charged either by using a booster or direct from a rotary converter equipped with sufficient regulator and transformer capacity for working at the higher voltage necessary for charging.

earlier sub-station bus-bar arrangements. In many large sub-stations all rotaries are operated from one set of bus-bars; in others they can be operated on either one of two sets of bus-bars. Another arrangement consists in running all rotaries from a single bus-bar arranged with disconnective knife switches, so that each rotary or group of rotaries could be operated independently from its own transmission lines. An improvement consists in replacing the disconnective knife switches with remotely controlled oil switches.

With the latter arrangement, each rotary or group of rotaries can be operated all in multiple if necessary or advisable, and be quickly sectionalized in case of trouble on any one transmission or conversion unit. An example is shown in Fig. 1, which gives the scheme of principal connections in a sub-station that was put into service about one year ago. There are twelve 500-kw rotary-converters arranged in three groups of four, each group supplied from its own high-tension line and delivering current to its own section of the direct-current bus-bars. The incoming lines, apparatus, cable connections and switchboards, and the low-tension feeders to street, are all located and arranged to prevent a bad burn-out spreading from one group to another.

On each rotary-converter there is mounted a direct-current circuit-

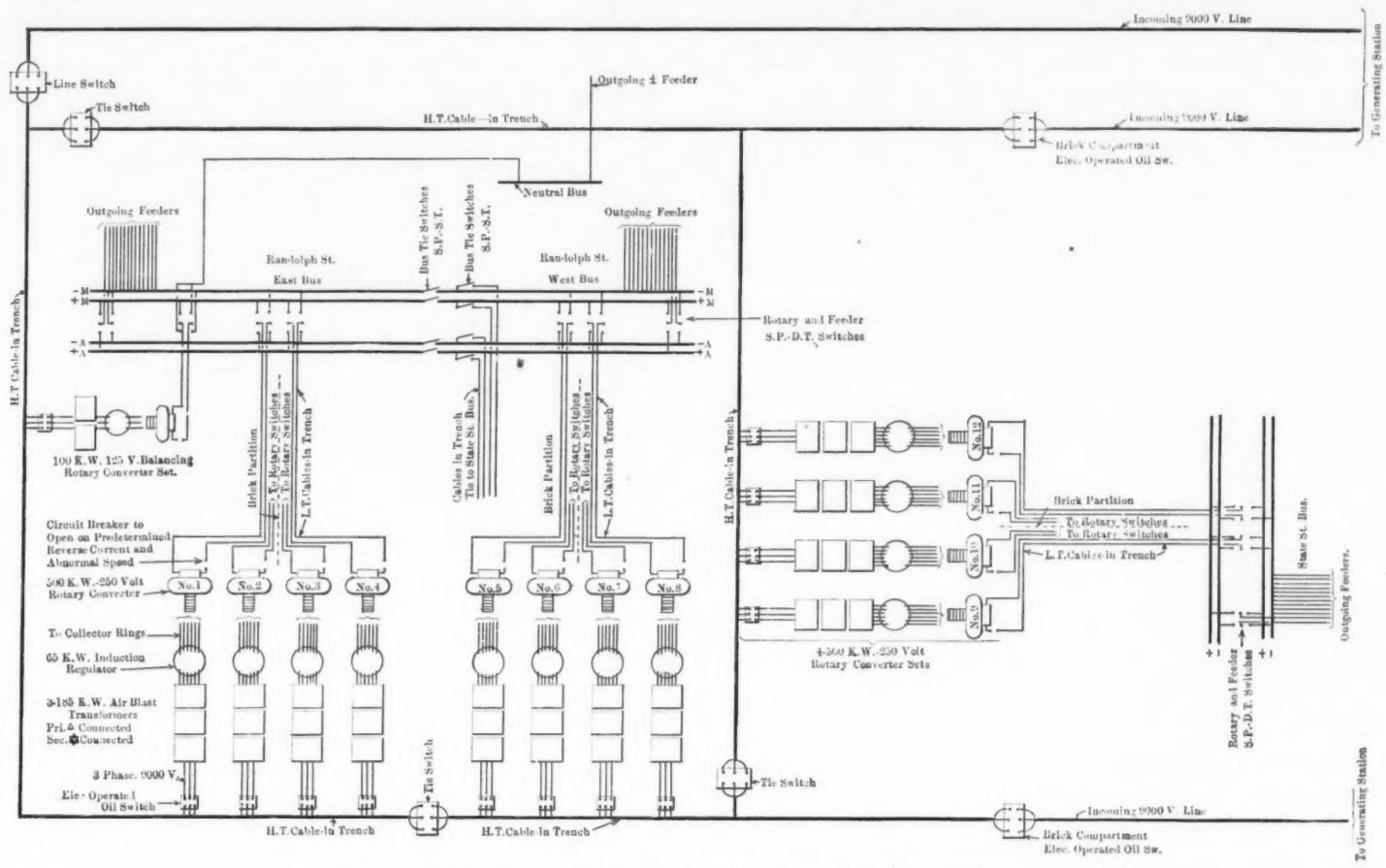


FIG. 1.—DIAGRAM OF PRINCIPAL CONNECTIONS IN SUB-STATION.

Even in a sub-station having a storage battery and a subsidiary steam plant, all of the annual kilowatt-hour output, except a few per-cent., is supplied to distribution system through the rotary converter. Special precautions are necessary to guard against interruption of service, as the radius of possible transmission of large powers in case of trouble is very much greater than in the case of services, mains or feeders.

The characteristics of a rotary converter are such that it will carry an enormous overload with very little drop in voltage. Serious troubles or short-circuits, whether they occur in the rotary-converter and accessories, in the direct-current connections or in the alternating-current connections, will be violent and are liable to be destructive unless the damaged unit can be quickly and effectually disconnected, both from the alternating-current transmission and the direct-current distribution systems. The localizing of trouble and the effectiveness of disconnecting depends on the arrangement of the alternating-current bus-bars and the automatic safety devices.

The practice of operating practically all units on a single set of bus-bars, at least during long-hour, light-load period in the direct-current generating stations, undoubtedly had some influence on the breaker operated only by means of a 125-volt trip-coil. A centrifugal speed-limit device on shaft closes the trip-coil circuit, thus disconnecting the rotary-converter from direct-current bus-bars and preventing its running away, the causes of which are well known. A reverse-current device also trips this circuit-breaker in any case of trouble that would draw more than a predetermined amount of energy from the direct-current bus-bars.

The oil switches on each individual rotary-converter outfit, and those used for tie switches, are all equipped with overload attachments, which are so adjusted that they will open only in case of serious trouble. The tie switches should also be equipped with interlocking devices, so that these tie switches between lines can be closed only when the two sources of e.m.f. are in synchronism. The low-tension feeders in most of the large Edison systems are provided with very heavy fuses and often with solid links. The adjustment of overload attachments on oil switches must, therefore, also be made for heavy loads and with due consideration for the particular conditions involved in each individual case.

TRANSMISSION SYSTEMS.

In most of the larger cities the 25-cycle transmission systems are

operated at voltages varying from 6,600 to 13,000 volts. Much higher voltages have been successfully used on through trunk lines, in several other cities. This, however, is obviously a very different condition. The large transmission systems with their multiplicity of lines, cable terminals and oil switch connections have grown into networks that are continually becoming more complex. As each and every case of serious trouble anwhere on a system having almost exclusively synchronous apparatus necessarily affects every part of the system, the possible chances for trouble affecting any one of the thousands of customers, are also continually increasing. Commercially, this is a very serious matter indeed, especially when we consider that with many of the more desirable customers the greatest possible security for continuous service is of first importance.

Realizing this fact, many central station engineers have taken extraordinary pains with high-tension cable work and in some cases have succeeded in making the transmission network in itself one of the most reliable parts of the central station system, except in so far that inherently this high-tension network with its synchronous apparatus is lacking in elasticity.

This has been the experience in Chicago, where a 2,250-volt, 25-cycle transmission line supplying rotary-converters, was first put into service about six years ago. Since then the transmissioin voltage has twice been doubled. The first line, three and one-half miles long, supplied one sub-station having 200-kw capacity in rotary-converters. The resulting high-tension system, shown in Fig. 2, will, by next fall, aggregate about 60 miles, supplying nineteen sub-stations with approximately 24,000 kw installed in rotary-converters and 4,000 kw in frequency-changing motor-generator sets.

About twelve months ago the potential was raised to 9,000 volts. The previous and subsequent experience indicated many desirable improvements. Until this time the system was supplied only through delta-connected step-up transformers from double-current generators.

The capacity effect of lines was found to be such that in event of slight ground on one phase, it might result in an excessive rise of potential and very severe strain, if not an actual break-down, on some part of system. The grounding of neutral on this high-tension system has been attended thus far with very satisfactory results. As star-wound 9,000-volt alternators were installed, the common point of winding was in each case connected to ground. Practically all high-tension transmission cable installed during the past two years consists of No. 4-00 three-conductor paper and lead-covered cable. The thickness of paper wall on each conductor is 6-32-in., over all is 4-32-in. and lead wall is ⅛-in.

The arrangement and installation of terminal appliances is obviously of great importance. All forms of fuses and air-break switches have been abandoned, so that at present the main circuits are made and broken only under oil. Various forms and methods of making up joints and cable heads were tried. These are now made up in parts, so that the lead sleeve or cylindrical part of head is put in place after the individual joints have been made and insulated with paper tape. The sleeve or cable head is then filled with a special compound, which is a non-absorbent of moisture and has a much higher dielectric strength than the paraffin which was formerly used. The process of filling is such that every minute particle of moisture is expelled.

The selection of routes for transmission cable is made with a view to provide two or more lines on different streets if possible, at least in different groups of conduit for each sub-station. The cables are isolated and mechanically protected, so that the spreading of a bad "burn-out" in either high or low-tension cables will be prevented as much as possible. A well-designed and constructed conduit and manhole system is, therefore, essential. Overhead connections to an extensive high-tension underground network are a source of trouble to be avoided, if possible. When unavoidable, these overhead taps should be isolated by means of transformers.

GENERATOR, PRIME MOVER AND AUXILIARIES.

The necessity for operating all units in multiple for long hour periods in order to obtain good station economy, still exists to a very large degree. During the past ten years the sizes of units in the largest stations have been increased from 800 and 1,500 kw to 3,500 and 5,000 kw. The number of units, however, in any one station has often been decreased, making multiple operation of at least a large portion of plant more necessary than before, and also placing much greater dependence on any one unit. Such stations have been and are still passing through a critical transition period. Every case of serious trouble on generator, engine or auxiliaries affects the entire system; but it frequently happens that the system cannot be sectionalized even into two parts without serious sacrifice in engine economy. The gradual increase in number of units will only partially relieve this situation.

The engine-driven unit is ordinarily one of the most uncertain elements in the central station system. Duplicate units are often installed and operated side by side under apparently the same conditions, and one, for a time at least, will prove much more reliable than the other. There is so much fitting, so many fine adjustments and valve settings, all of which must be done with great care, precision and patience. Much depends also on the faithfulness and the skill of the men in immediate charge of the apparatus. This is true of any similar apparatus, but particularly of the large engine-driven units operating in multiple on transmission systems.

With an arrangement of bus-bars, high-tension lines and sub-station apparatus similar to that shown in Fig. 2, generating units can be operated independently, and a certain amount of shifting of

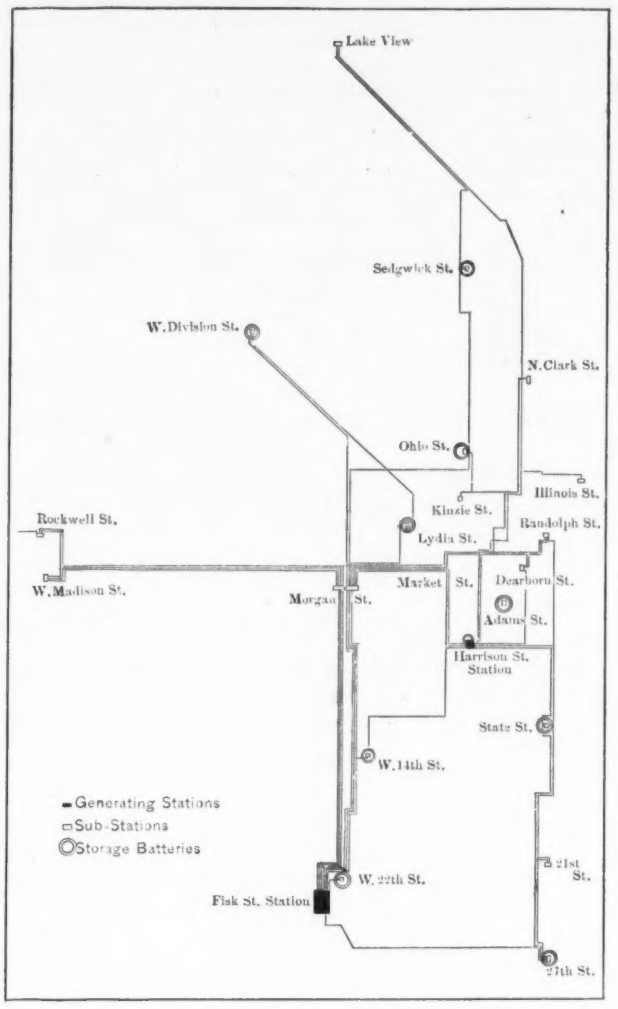


FIG. 2.—DIAGRAM OF DISTRIBUTION SYSTEM.

load can be done at the larger sub-stations having four or more units in service. Rotaries can be shut down one at a time, transferred to another generating unit or another station and again put on load. During peak hours there would be shifting which would introduce some additional chances of trouble due to possible mistakes of men handling apparatus, which, in that case, would partly offset some of the advantages of sectionalizing.

In this respect, a very decided advance would be the use of a prime mover giving practically a straight line economy, such as the steam turbine. The differences between one-half load and full load performance for short hour periods will not be great enough to warrant much shifting. The auxiliary apparatus, particularly the condensing plant, is frequently a cause of trouble. The "sticking" of pumps, "dropping" of vacuum, and similar reports, are heard occasionally in every steam plant. The arrangement should be such that the condensing plant and auxiliary apparatus and the excitation of any one unit are simple and positive in operation and normally independent of every other unit.

STEAM SUPPLY.

Practically every steam plant has its own peculiarities in piping and arrangement of boilers, but in most cases all boilers are in one room. The bursting of a steam pipe or boiler tube fills the entire room with steam instantly, making it impossible to close a valve in the ordinary way. The location of boilers in two or three different rooms or floors and the providing of means for closing valves from inside of engine room has lessened the danger of a shut-down. The placing in separate rooms, as far as circumstances will permit, of the boilers and piping corresponding to each generating unit and connecting only through fairly quick-acting remotely-controlled valves will further lessen this danger.

With careful operation, customers' troubles (bad or interrupted service, that are chargeable to the boiler room are few, while those of the central station manager are many. Investigations, experiments and some improvements have been made from year to year, but the buying and economical handling of coal and making of steam still involve problems that are worthy of the very best attention, both as to the cost of operation and reliability of service rendered. These problems are especially important when we consider large stations which consume 2,500 or 3,000 tons daily, and the many possible chances of delay and interruption between the coal mine and the boiler room.

GENERAL CONSIDERATIONS.

A survey of the various classes of trouble between coal pile and customers' service indicates at once the unfortunate feature of large modern transmission systems. True, as has been done in some cases, induction motor-generators might be used instead of rotary-converters. The sub-station apparatus would then be much less sensitive to sudden fluctuations in engine speed, or to line disturbances due to short circuit on some other part of the system.

The first cost of motor-generators of 500-kw and 1,000-kw capacity installed complete is, however, from 15 to 25 per cent. greater than for rotary converters with accessories. Under ordinary operating conditions there is a difference of from 3 to 5 per cent. in efficiency in favor of rotary converters. The power factor of the rotary-converter is obviously much better than that of the induction motor. The characteristics of a rotary-converter are often a practical advantage in cases of trouble on low-tension feeders or mains.

In some few cases where it is necessary to run a large number of converting units from a long transmission line which itself is subject to heavy fluctuations in potential and frequent interruptions, it may be advisable to use motor-generator sets. In the large majority of cases, however, in both lighting and railway work, the rotary-converter has been found the best and most economical. If the objectionable features thus introduced cannot be overcome, the result can at least be minimized by judicious sectionalizing in large systems.

The electrostatic capacity of these large high-tension cable systems is such that there is necessarily a practical limit to the mileage of cable that can safely be operated as an interconnected network. In the 60 miles of 9,000-volt, three-phase, 25-cycle lines previously mentioned the charging current as calculated will be about 16 amp. At the present rate of increase in mileage the condenser effects will soon be troublesome and possibly prohibitive, as troubles may occur which will result in building up a potential at some point and breaking down insulation on apparatus that was comparatively safe on the smaller system. In that event, and with several very large units all in multiple, the amount of power delivered on short circuit would probably be so great that it could not safely be interrupted by any oil switch thus far built.

In a rapidly growing system provision for a reasonable amount of sectionalizing can easily be made. The investment in the portion of central station system between coal pile and customers' service most directly involved, is, under most conditions, divided approximately as follows:

Station-real estate, building and generating apparatus	35% to 45%
Transmission system-cables and conduit	3% to 6%
Sub-station-real estate, building and converting apparatus	10% to 15%
Feeders and mains-cables, conduit and Edison tubs	40% to 48%

These percentages are greatly influenced by local conditions, such as average and maximum density of load; value per duct-foot of underground conduit; average length and voltage of transmission; cost of real estate and character of buildings. In railway plants, the investment in sub-stations and that corresponding to feeders and mains will be less, while the investment in transmission lines will be somewhat greater. A considerable capacity in storage batteries will, under load conditions obtaining in most large systems, decrease slightly the investment in the first three, but would not affect that in feeders and mains.

The provision for sectionalizing will not increase the investment or operating costs, either in sub-stations or in feeders and mains. In the transmision system it may, under some conditions, slightly increase the total mileage of lines; but such an increase in the 3 to 6 per cent. thus involved is a very small increase in the total investment in entire system.

A review of power houses indicates that there is a wide difference in cost of station buildings. This difference is a matter partly of engineering and partly of management. Taking the total cubical contents of six of the large modern station buildings, we find that from 6 to 10 per cent. is devoted to coal storage and that the complete buildings vary from 100 to 240 cu. ft., and from .95 to 2.5 sq. ft. per kw-rated generating capacity. The boiler room portion of the same stations vary in total net cubical contents from 65 to 130 cu. ft. per rated boiler horse-power, while the engine room portions vary from 40 to 90 cu. ft. per rated engine horse-power. As practically the same types of boilers are used, the former depends almost entirely upon the design and arrangement; but the latter depends largely upon the type of generating unit adopted. In the case of vertical

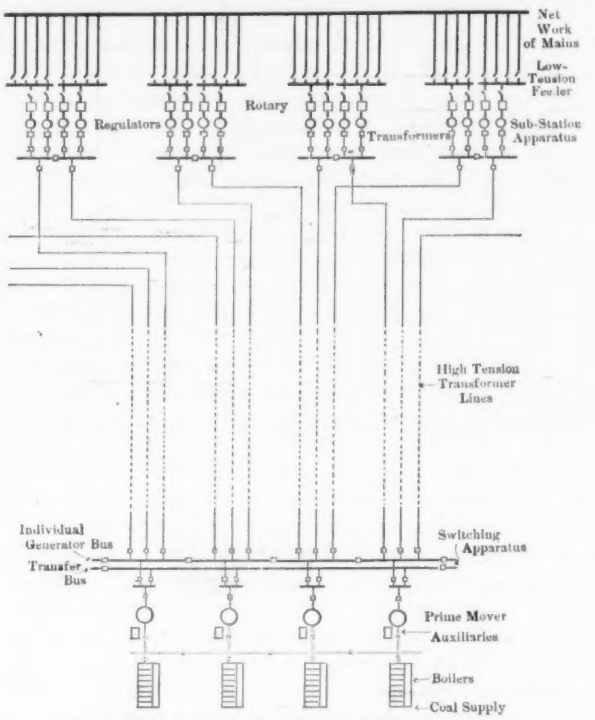


FIG. 3.—DIAGRAM OF DISTRIBUTION SYSTEM.

turbine-driven units, the figure for this portion of plant can be reduced by at least one-half.

The tendency, however, in power house design is toward a much more liberal allowance for space for all equipment. The high-voltage generators of large capacity and multiplicity of lines demand extraordinary switching apparatus which requires considerable space. A suitable arrangement and reasonable isolation of switching apparatus and connections need not require any additional space and should preferably be much simpler than that in many existing stations.

It would seem, therefore, that in the large modern power house sectionalizing and even entirely independent operation of units can be provided for with very little, if any, additional investment in the generating station or in any other part of the system.

While the independent operation of generating units would tend to minimize the effect on customers of many central station troubles and thus increase the co-efficient of reliability, there will also be some disadvantages. A heavy overload or perhaps short circuit coming entirely on one unit or group of lines might trip the oil circuit-breaking switches on lines, and the sudden release from load severely strain the prime mover. This cause would be improbable if, as indicated in Fig. 3, each generating unit supplies at least two different sub-stations and when only part of the load would be thus released on any one generating unit.

If a short circuit occurs on a feeder supplied by a small group of rotaries, the percentage of overload is larger and after one

rotary trips, the others will immediately follow. This might not have occurred with a larger group, when the percentage of overload would have been correspondingly less. All transmission lines should be equipped so that oil circuit-breakers at both ends of line open automatically in case of trouble, whether the entire system is operated in multiple or independently.

In the latter event, if time limit attachments are used with overload devices at the station, the amount of energy delivered at the point of break-down might not only slow down the engine, but draw enough energy from network to trip the circuit-breakers on all rotaries supplied from the particular generating unit. If operated, as shown in Fig. 3, this would mean, under full conditions, an overload of 50 per cent. on the remaining rotaries in each sub-station supplied from three different generating units; 100 per cent. overload on those supplied from two, and a total shut-down of such small sub-stations as are supplied exclusively from the particular unit in trouble. Usual result: low pressure on part of direct-current system; no trouble elsewhere.

In event of multiple operation of the entire system, with several units in service, a large amount of energy from the station bus-bars would be delivered until time limit overload devices at the station and reverse current devices at the sub-station cut out the troublesome line. Usual result: heavy fluctuations in pressure on entire system, until line is opened at both ends, several machines shut down and sometimes a total shut-down.

During the hours of light load the system would naturally be divided into fewer parts or perhaps all in multiple. In event of a shut-down during these hours, the capacity of storage batteries would be so much greater in proportion to load that the drop in pressure would not be so serious.

The successful operation of large systems necessitates the maintaining of a well-organized operating force of competent and experienced men. Every operation involving the starting or shutting down of a generator, line or sub-station unit should be carefully regulated and checked to reduce to a minimum the possibility of a mistake. In one of the large stations now under construction provision is made for a load dispatcher, whose office will be convenient to the operating switchboard and who can control absolutely the transferring of load between all generating, transmitting and converting units, with the same implicit confidence and accuracy of judgment and action as can the train dispatcher on an important railroad system. His office should be a clearing house for all orders concerning operation of system.

After considering some of the advantages and disadvantages of multiple and independent operation in large underground transmission systems, it might be of interest to consider small overhead systems. The latter are operated independently, in very many cases with satisfactory results as to reliability of service rendered. In order to secure more economical engine performance, it was necessary to adopt large units operating in multiple. This step also improved the reliability of service rendered, particularly where each feeder emanating from the bus-bars continued to supply its own independent system. If these small systems of taps radiating from a center of distribution at feeder ends, had been arranged into one interconnected overhead network covering a large area, the coefficient of reliability with the same character of construction would undoubtedly have been decreased. These systems, usually supplying current for induction motors and for lighting, are fairly elastic; but on account of the higher potential usually, 2,000 volts or more, a short circuit obviously affects a very large area and often the entire system. The matter of regulation being comparatively easy, there is, therefore, a distinct advantage in operating independently the different feeders instead of on an interconnected network. With an overhead system exposed to the elements and so many chances of interference from an exterior source, a modern station is usually the more reliable part of a system, and therefore there is little necessity of sectionalizing the station. As a precautionary measure, however, and to facilitate future extensions and repairs, stations should be designed so that this can be done.

In conclusion, it might be said that considering responsibility for the business and return on investment, every central station system should be designed, if not for independent, at least for sectional operation. In the very large stations, the independent units from coal pile to distributing network, or to rails, should be effectively isolated to make a total shut-down practically impossible. The matter of independent, sectional or multiple operation at different hours of the day or days of the year is entirely one of local conditions, which may change frequently. Great care and constant attention is needed to maintain a fairly uniform and consistent coefficient of reliability on every part of the central station system. Independent and even sectional operation will mean a small sacrifice in operating costs. With a system properly designed, this matter, then, becomes to the central station management a plain business consideration; to take the risk of inferior service and possible shut-down, or to pay a premium in the form of very slight sacrifice in operating costs and thus obtain an additional safeguard for superior service to all or such groups of customers as business requirements may demand.

Multiple-Rate Metering.

The specifications of a patent recently issued to Prof. Elihu Thomson and Mr. F. P. Cox contain an interesting discussion of multiple-rate metering, which we reproduce below:

In the art of electric measurement of energy two systems in addition to the older one of directly indicating the current-flow in either watts or amperes have come into use. The old system is to measure the energy in watt-hours or ampere-hours, as may be desired, and to make to the consumer a charge based directly upon the consumption. To encourage the use of current at times when the station is not fully loaded and as nearly as possible equalize the total load, thus diminishing the cost of energy and increasing the efficiency of the boilers, engines and generators, which, as is well known, are best adapted to maintain their full load (or work at highest efficiency when run near full load), the two other systems have been devised. One of these methods is to use a two-rate meter, which by various contrivances is adapted to register at a given rate during part of the day and at a lower or higher rate during another part of each twenty-four hours.

Various forms of this device have been elaborated, some of which indicate the two charges on different dials, and some of which simply shift mechanism of one sort or another, so as to effect a direct change in the registration, measuring all of the energy upon a single set of dials.

Another system which has been developed is the so-called "maximum-demand" system of bookkeeping, which consists in its essence of making a certain fixed charge proportioned to the maximum energy which may be consumed in a given branch circuit at any time and over and above that another charge proportioned to the actual energy consumed.

There are inherent inequitable features in each of these systems. The maximum demand, for instance, may be established for any month or other period by factors which do not give a true measure of the probable demand for current which the station must supply to the branch circuit under consideration. For instance, in some forms of such devices an accidental short circuit or a very unusual supply of current taken for only a brief period may be registered as a basis for the fixed charge referred to, although such a demand may not occur again for months or years, and this leads to dissatisfaction on the part of the customer and is manifestly unfair. The charge also has no relation to the station load, and being the same no matter at what time the demand occurs, has no tendency to encourage consumption at times of small station load.

Similarly, two-rate meters as heretofore developed have in a measure been open to some objections. For example, the change of rate is made at a certain definite time (where it is effected by clockwork attached to each meter), and this time should vary at different seasons of the year, whereas the mechanism of a clock is such that the period of high charge is not ordinarily susceptible of variation. Furthermore, the change in the rate of registration is effected all at once, so that during the transition from light load at the station to full load, which is always more or less gradual, the consumer is paying either at a less rate or a greater one than is equitable either to him or to the station.

The invention of the Thomson-Cox patent relates to the latter type of two-rate meters. By means of clockwork actuating a cam, resistance is cut into the meter circuit to effect a registration varying with the state of the station load. That is, varying by steps the rate of registration, for example, from the beginning of a peak load to its culmination, and then in reverse order as the load decreases. By suitably shaping the cam, the meter may be made to meet any local condition.

Discussion of A. I. E. E. Central Station Papers.

Owing to lack of space, only a brief abstract could be printed in the issue of last week of the discussion on the Institute papers of Messrs. Lardner, Torchio and Junkersfeld. As this discussion was quite full and of much interest, we give below the greater part of it.

In opening the discussion, President Scott said that the papers of the evening were of exceptional value on account of their particular character. In dealing with the subject of central station practice, they have not gone into generalities; they have not dealt with matters in a theoretical way; but the last two papers, in particular, are what might be called heart-to-heart talks from the men who have been operating large stations for a considerable time. The burden of the papers, particularly of the last two, and a strong sentiment in the first paper, is notable—it is not on the general theory of the interrelation of parts; not on the characteristics of engines or dynamos, of efficiency or regulation, but the papers refer to those elements which come up in connection with the design of the station beforehand, which have more to do with the operation of the station, which affect the man who runs the station. They have to do more particularly with the emergency conditions, with safety devices; and through all the papers we have this sentiment—how shall we protect the station against emergencies and interruption of service? We almost might be led to think, from what has been said, that these are chapters from experience, and one might almost conclude that Mr. Torchio has given us the results of thirty-three accidents and shut-downs in his system; but we fortunately have already been assured that this is not entirely the case, by Mr. Lieb's statement that this same system has been running since its beginning always with some current on its lines, and for some ten years with no interruption of the service.

Mr. Stott thought the present occasion was a good time for us to look back historically. We have been told a good deal about modern tendencies. History seems to repeat itself. We started out fifteen years ago with one machine and one circuit all the way through; a little later it became a question of adopting two or three circuits, and having them so divided as to suit the size of the units. A little later the size of the units was increased, and also the size of the feeders which they supplied. Then it became a problem of combinations, how to adapt the feeders to the size of the machines. At that time everything was run, practically, with high-speed engines and high-speed belted generators. Following that came the period of slow-speed engines, and we began to look then into the possibilities of multiple operation. Multiple operation meant, instead of running five, six or eight small units, on perhaps fifty per cent. load for a greater part of the time until the load went down sufficiently, a combination of the service on one or more machines, thus producing a fair load factor. Then as soon as multiple operation came with slow-speed engines, we began to look around for some further development; and there seems to be at the present time a tendency to go back to the higher speed generator, such as the steam turbine. The steam turbine is practically an unknown quantity to most of us, and whilst some results have been published, yet it has not been in use long enough to justify a prediction that it will displace reciprocating engines. Reciprocating engines to-day are built with higher steam economy than is claimed for the turbine. He understood that tests with the Sulzer engines in the Berlin Moabite station show a consumption of 8.97 lbs. of steam per indicated horse-power. The larger units in operation in New York to-day are all approximately consuming about 13 lbs. of steam per indicated horse-power. That corresponds approximately to 19 lbs. per kw-hour. The best of actual records of the steam turbine is just about that. By going into triple-expansion engines, a step which seems obvious for railway power plants, we can get down twenty per cent. lower than that, without any trouble at all. In a message just received from the Boston Edison Company it is stated that with a 1,200-hp compound condensing engine, with 98° of superheat at the throttle, they got a steam consumption of 11.57 lbs. per indicated horse-power. At the present time he felt personally, in regard to the steam turbine, that we will have to return the Scotch verdict of "Not Proven," and wait until we get actual results.

The feature of floor plan, the space in relation to the general size of the plant and the unit, has been referred to. He thought a little consideration will show that the size of the generator unit has nothing to do with it. It is the size of the boiler room. If we can reduce the size of the boilers, we can reduce the size of the station, but to get an economical distribution of steam from any plant we must run the boiler room parallel to the engine room. He believed we will find the limiting feature in all large stations—no matter what the size of the generator unit—is that we must have a certain size of boiler unit, and to get the best distribution of steam, even though the units only occupied one-fourth of the space claimed for the steam turbine, you would have to space the steam turbine units at approximately the same centering distance as you do the steam engine, so that the economy of floor space is not a very important point.

Coming to the transmission lines, the claim has been made, and it perhaps dwells in the minds of many able engineers, that the high-tension lines are very dangerous. He differs from that and thinks the high-tension underground cable is the safest thing we have—a great deal safer than low-tension. If you have a short circuit in a low-tension cable it may burn up a thousand feet of the cable before you can stop it. If there is a short circuit on a high-tension cable, with proper safety appliances on each end of it, should a burn-out occur it does not destroy more than two feet of the cable. There is quite a large capacity on the bus-bars in the Manhattan plant, all in multiple, and a short circuit on the high-tension feeder, 11,000 volts only gave a puncture such as you would get from a station transformer, not destroying more than two feet of the cable; whereas with a short circuit on a 600-volt, direct-current cable, a large amount of cable may be readily destroyed.

Referring to storage batteries, Mr. Stott considered that the storage battery has found its proper place as an assurance against shut-down and not as a means of economical operation. That statement is probably open to discussion, and he would be glad to hear it discussed. It seems to be almost impossible to find a condition in which the storage battery pays for itself as an investment. He considered it essentially as an insurance, and not as an element in economical operation that the storage battery finds its best applications.

The idea which seems to pervade in all of these papers, the returning to the single operation of units on a certain number of feeders, or employing a certain number of sub-stations, and not multiple operation, seems to be a backward step. It is a confession of weakness in our safety devices. Is it not a better solution to improve the safety devices and operate in multiple and thereby gain the maximum economy of station operation? The price of coal is soaring all the time and apparently always will do so, and in the economical operation of a power plant coal forms over sixty per cent. of the actual cost of power; and it is, therefore, most important for us to do everything possible to economize in the operation of the plant, and this can only be done by running the units as near full load as possible, and to do this we must run in multiple. The separation of high-tension apparatus can be very easily carried out, and it seems to me that by means of proper appliances as indicated in Mr. Torchio's paper, and as actually carried out, there is no difficulty whatever in making a station practically safe in all kinds of operation. He has seen an actual short circuit in a station with four 5,000-kw machines in multiple, and an oil switch take care of it perfectly, long before the attendant could touch the switch and throw it out. With a switching apparatus brought down to such pefection as this, it seems to me that we ought to be very careful about reducing the efficiency of operation of our plants by going into independent units.

Mr. Herbert A. Wagner said he has recently been connected with the engineering work of the Boston Edison Company, and there all the alternating-current generators and feeders are operated in multiple, and with practically no trouble. The generating station, until three years ago, was used for alternating-current distribution only. No rotaries or motor-generators were used prior to that time. That was the station of the Boston Electric Light Company, which was consolidated with the Edison Illuminating Company, of Boston, and then the change was gradually made, and has been entirely made by this time, from alternating-current distribution in the city proper to alternating-current transmission and distribution by the old Edison low-tension system and extensions thereto. The alternating-current generating station, therefore, is now used entirely for transmitting current to sub-stations from which current is distributed on the three-wire, direct-current system. All these sub-stations are equipped with motor-generators in place of rotary transformers, and Mr. Wagner attributed the freedom from many of the troubles which other central stations had to the use of motor-generators in place of rotaries. A large proportion are induction motor-generators, and therefore the troubles which are often caused by synchronous apparatus are entirely obviated. Of course, there is something to be

said against the use of motor-generators. The first cost is something more; the power factor with induction motor-generators is lower, but with a proper apportioning between induction motor-generators and synchronous motor-generators that can be obviated.

The company is now building a 50,000-kw station in which turbines are to be used entirely in place of engines, in 5,000-kw units. That station will probably be operated in sections, but this has not been definitely determined upon yet. Referring to a statement of Mr. Scott, Mr. Wagner said that the engine economy which he quoted refers to a cross-compound engine. In fact, all the engines are cross-compound, of McIntosh & Seymour make. No triple-expansion engines are used, except some very old ones built by the General Electric Company a good many years ago, of small size. The German practice and experience has shown that there is nothing to be gained by the use of triple-expansion over compound engines, especially without superheating. They have carried superheating to a very much higher degree there than here, as they have used independent superheaters. In this country nothing over 100° has been reached, and that is much above the average practice; 75 to 80° superheating is probably the best that has been obtained in practice, and that is quite varied. With a high degree of superheating the cross-compound engine can be made fully as economical as the triple-expansion engine; single-cylinder engines, with high degree of superheat, have almost equalled triple-expansion engines, but the difficulty of using such high degrees of superheat is almost insurmountable, especially with the type of engines used in this country.

Mr. E. H. Sniffen, in referring to some statements made concerning steam turbines, said that we are all tolerably familiar with what the reciprocating engine will do, and it is probably a fair statement to say that the steam turbine will not give materially better results, under test, than the best-known results of reciprocating engines. That is a fair statement for full-load regulation, although under light loads the turbine is more economical. As we accumulate experience we will find a distinct difference between the inherent, commercial, every-day efficiency of the turbine and the reciprocating engine. This has been already shown by the amount of experience we have had. At Hartford, Conn., where there is a good-sized turbine running a 1,500-kw machine, they have found by pretty careful experiments that they develop about 1,900 kw with the steam turbine, as against 900 kw with two Corliss engines, with the same fuel consumption. Possibly these engines are not in the very best condition; it may be the valves are not well seated, or the internal condition of the engine is not exactly as it should be. The turbine, of course, is direct-connected, and the engines drive the generators by belting, and to the belt drive we may ascribe some of the deficiencies of the steam engine, but certainly not all of it. We should not be misled in comparing the efficiency of two different types of apparatus simply by tests of them, unless the results are obtained by every-day use. As these new plants are installed and we get the actual results of the commercial operation, Mr. Sniffen thinks that in inherent efficiency a very marked improvement in the steam turbine will be demonstrated.

Mr. John W. Lieb, Jr., said that in reading over Mr. Junkersfeld's and Mr. Torchio's papers one would be almost inclined to think that Mr. Lardner had a great advantage from the standpoint of safety of operation in a considerable number of smaller stations. He thought, however, that Mr. Lardner, in his statement of the case for a multiplicity of smaller stations, has probably not taken into consideration the extremely important factor in locating such smaller stations in such a city as New York. He certainly did not agree with his statement that it is not a difficult matter to locate smaller stations within the Borough of Manhattan. Any one who has undertaken to operate an electric light station on Manhattan Island will have become very soon convinced of the great difficulties which attend a selection, such as the bringing of coal to the station and the drawing away of ashes, and the liability of annoyance to the people living in the neighborhood, and these things are all included in the difficulties of securing a proper location. As the state of the art progresses to a point where it is possible to concentrate the chief generating plant, so that these objectionable features are minimized, it soon becomes evident that this is a step which one is practically forced to take.

If prospective customers of the electric light and power companies could read over this very formidable list of all kinds of automatic overload and underload relays, and other things tributary to the operation, that are a necessary concomitant of a large power station, he feared that the contracts which would come in would be few and far between; but as a matter of fact these different requisites are rather in the direction of extreme refinement, necessary to secure the greatest regularity of service and the greatest freedom from disturbance; and not only mere disturbances which would affect the customer, because a great many of these contrivances which have been referred to as being necessary to the operation of a large power station might not be necessary as far as simply giving service which the customer would consider as absolutely regular. It is on account of the extremely high requirement that is placed upon the system so that the service shall be above reproach in every respect, and not so much from the standpoint of continuity as from regularity and constancy of the supplied voltage.

The papers link one thing very closely with the problem of whether we shall have one large station or a number of small stations, and that is what one of the gentlemen has referred to as the commercial risk. It is perhaps true that if an accident should happen to a large station that it may possibly involve a larger territory, and therefore perhaps might not be as absolutely safe as a number of small units; yet that safety can by proper engineering methods and careful installation be reduced to a point where the risk is entirely a commercial one. That has been fairly demonstrated in the operation of the large central stations which have supplied the larger cities where the exigencies of the service are of the very greatest. Mr. Lieb emphasized the absolute necessity, as an auxiliary, of storage batteries in such systems of distribution. It is perfectly safe to say that the experience of all large central stations operating transmission systems to sub-stations has shown that the storage battery has impressed itself upon them as an absolute necessity, as much a necessity as an auxiliary as either the rotary converters or motor-generator sets, or some other of the equally essential pieces of apparatus.

In connection with the consideration of the cost of production, Mr. Lardner, in his enumeration, has made, it seems, a rather formidable list of advantages of the large stations and has cited as the principal and only disadvantage of the large station the possibility of current interruption; but he has not, perhaps, sufficiently emphasized the very large difference between operating a dozen or more small plants and one large plant. In the case of a large number of smaller plants the volume is large of what may be called unproductive labor; in other words, the people you have got to keep at the smaller plant, no matter what its output may be, and even if there be practically no output—a certain amount of superintendence, a certain amount of janitor work, a certain number of unproductive people, who must be employed in the small plants, and who are done away with if the system is concentrated in one large power plant. While the various matters which have been brought forward during the evening might seem to indicate that the service from these larger plants may perhaps be less reliable than the service from a multiplicity of smaller plants, experience sufficiently demonstrates that the service which the large plants can produce is sufficiently constant and reliable for the most exigent and difficult conditions.

Mr. Townsend Walcott remarked, in reference to a statement in Mr. Lardner's paper respecting the use of superheated steam in steam turbines, that if he understands the theory of the steam turbine, there would not be the same advantage in the use of superheated steam as in the reciprocating engine. The superheating of steam in the ordinary engine prevents condensation in the cylinder, whereas in the steam turbine the steam expands without doing any work. Superheating would thus only be putting more energy there which could not be recovered.

Mr. W. S. Rugg said that Mr. Lardner brought out the point that we can expect nearly the same economy of operation with a small station as we can expect in the operation of a large station, which is an important point, and one with which we are all familiar. Mr. Lieb has also brought out the point that the cost of operating such a number of plants has increased very greatly over the cost of operating a single large plant. Mr. Torchio has called our attention to the importance of isolating and duplicating the various parts of the distribution system. This is one of the points in which most advancement has been made in central station practice in the last few years, and one which is not as well known and as evident as other matters, because it is somewhat hidden and not as carefully looked into as the power house itself. Mr. Junkersfeld called attention to the importance of isolating the power plant and dividing it into

several units. This is a point which has not been considered as favorably as it should be, and it is of vital importance to consider these various facts. It is surprising that we have not heard brought out, and especially we have yet to see the first attempt, to actually lay out an Edison multiple-unit station. In such a station we could combine nearly all the advantages which have been brought out in the papers. Such a station could be designed so that the operating expenses would be but very little more than the operating expenses in one room, or two rooms, and at the same time we would have the advantage of a number of stations. This principle is well recognized in the design of small stations. We would not have to tie two small stations up in one unit, but we do not hesitate to defend some of the large stations of the country in which the entire station practically depends upon the continuity of operation of a single system.

Mr. A. V. Abbott spoke of another side of the question, which is important from the manager's standpoint. May we not consider the question of safety appliances and the question of the subdivision of the station into a number of units, partly from an insurance standpoint? In one of the papers the Niagara plant was referred to and it was stated that after the accident there, the engineers of the plant said there should have been two bridges, or two sets of cables. That is an easy thing to say after the accident has occurred, but it is quite probable that the engineers considered one set of bridges and one set of cables amply sufficient considering the probability of interference with the service. To put it in another way: Suppose, for example, all of the service of New York was concentrated into a single plant. There would undoubtedly be more or less probability of interference to the service occasionally. On the other hand, if we can imagine New York supplied by a hundred plants, the probability of any serious interruption would be almost nothing, because if one or two of these hundred plants were put out of commission, the other ninety-eight or ninety-nine would be amply sufficient to carry the service for such a period of time as would enable the repairs to the one or two plants to be made. On the other hand, it is also quite certain that the expense of generation, expense of supply and the capital invested would be very much increased. Let us suppose there was an insurance company which would go into the business of insuring both customers and the electric light plant and should take up the question something in this fashion: For a certain amount per kilowatt-hour per annum, we will insure you positively against interruption in just the same way that a fire insurance company insures the merchant against the destruction of his building; or, in other words, the company will pay for whatever actual damages occurred due to interruption of electrical service. That is a business proposition. The insurance company could also say to the electric light company: You may put in so much less apparatus, so much less capital, have so many less bonds on which to pay interest, because we will assume the risk of indemnifying your customers for any interruption that occurs.

Would it not be possible for some of us to contribute to the general fund of information to endeavor to show, perhaps in the form of a curve, a certain relation between the number of accidents and delays between the large station and a multiplicity of small stations, and the amount of capital that would be invested therein, and reach some sort of a plan on which insurance companies could go into the field and insure electric light companies and their customers against the probability of interruption of service? We should take this question up not solely from the engineering standpoint, but from the business standpoint as well. The engineer should make everything absolutely safe, so far as his knowledge will permit, because there are always sufficient exigencies in the unknown which we cannot recognize; on the other side, there is the commercial point of view, and it is desirable that some light should be thrown on that phase of this question.

Mr. Junkersfeld said that the question proposed seems to be one of preference between a multiplicity of small stations as against one large plant. Mr. Lieb pointed out that a multiplicity of plants is impracticable, because you cannot get suitable real estate. For that reason the companies are forced to concentrate their power stations in places where coal and water can be easily secured. Mr. Lieb has covered the proposition very clearly, and as far as Chicago is concerned he endorsed his remarks. The same conditions apply in Chicago; a great multiplicity of plants is impracticable, and sites could not be secured for them, even though we tried to do so. Mr. Stott made the remark he would rather have trouble on a high-tension cable than a low-tension cable, and that in his experience there is really very little trouble from that source. In this he fully agreed. At Chicago there has been very little trouble, as far as the cable itself is concerned, in the high-tension work, in transmitting trouble from one part of the circuit to the other.

The question of the storage battery was brought up by Mr. Stott with the statement that as an investment he could not consider it economically. That is largely a question of conditions. In the Manhattan station perhaps he cannot see any great saving in installing storage batteries, but in the lighting business, with narrow peak, it is easy to see how a storage battery can be installed and used with profit up to a certain capacity. If you cut off enough of the peak so that it is more than an hour or an hour and a quarter, the battery will not pay. With a peak of one hour the battery will pay. Returning to multiple and independent operation, it has been shown in some of the papers and during the discussion that a multiplicity of plants has some safeguard over and above one large plant; and with this idea in view the work in Chicago has been carried on with the idea of centralizing the sub-stations in a transmission system. They have been built and run independently, as the units were quite large, and very little sectional operation was possible on that account. With the installation of the turbine units, with a good load economy, sectionalized operation will be entirely possible. He was glad to know that in New York they had actually started operating their large plant in two sections, where they are employing reciprocating engines. That they have found this possible here in New York, will be given quite a good deal of consideration, because, after all, what is done in these larger lighting stations is based on wide experience, and is a matter of interest to all stations.

Mr. Lardner said no one knows better than Mr. Lieb the difficulties of operating small stations in New York, or of securing locations which shall insure the company freedom from complaint due to the annoyance incident to such plants. He said he had been slightly misunderstood, as he did not advocate a multiplicity of plants, but subdivision into a few plants instead of one large plant; perhaps two or three. As to the difficulty of securing sites in New York City, there is the site at Kingsbridge, at Two Hundred and Nineteenth Street, at Ninety-fourth Street, at Seventy-fourth Street, at Thirty-eighth Street, and at North River and Fifty-ninth Street. These five suitable locations have been found, and the engineers of the respective companies probably each think each has the best site.

Mr. Torchio, referring to Mr. Lardner's remark with reference to the locations of power plants in New York, said that the only stations he has mentioned on the water front are high-tension current stations, and he asked if he meant that the New York Edison Company should have multiple low-tension stations along the water front. In reply, Mr. Lardner said he suggested the advisability of two or three high-tension stations; not low-tension ones. Mr. Torchio then proceeded to say that a low-tension station would be out of the question. He took issue with Mr. Stott in his statement that there is no place for the storage battery from the standpoint of economy. The local conditions in New York City are such that they have the big load of the station supplying the commercial district downtown below Eighth Street, where the load diagram is very light in the daytime and then about 5 o'clock there is a full peak, and a sharp drop. A storage battery at that point, with a peak of short duration, can show advantages from an investment standpoint because in this case you can discharge the battery in one hour and you do not require the battery as a reserve. Having the battery, you have two advantages as to capacity and reserve during the operation. In reply to an inquiry from Mr. Stott, Mr. Torchio said the battery is discharged at this period at the maximum rate of discharge. Where there is a lighting load extending for three or four hours in the other district, the question is different. He said he had in mind a load diagram of the power station of the Milan Edison Company in Italy, operating a transmissiion line—a water power plant—where they transmit 10,000 kw and sell a good deal of power to industrial motors, and also for running the railway in the city as well as for lighting. At the peak a very large battery takes care of the lighting load. They sell power in Milan in the neighborhood of $60 per yearly horse-power, and that battery for a few days in the year enables the company to sell annually an additional three or four thousand kilowatts. In this case the efficiency of the battery is of no importance as a commercial consideration. You get 4,000 hp at $60 a year.

Telephone Exchanges.—II.

By Arthur V. Abbott, C. E.

RECEIVER WINDINGS.

THE illustrations in Figs. 10 and 11 are diagrams of a pair of telephone lines as they would appear when connected for conversation. In Fig. 10 the sub-stations are shown as equipped with a local battery transmitter and receiver. The lines then extend to the office into a branch terminal switchboard, and are connected by the usual cord and plug. In Fig. 11 common battery sub-stations and switchboard are represented. The approximate resistances of the various parts of the circuit in both illustrations are given, for the object of these illustrations is simply to convey a faint mental picture of the chief conditions which prevail during a telephonic conversation.

When one speaks into one of the transmitters the result is to produce (as will be subsequently explained in the paragraphs on transmitters) an undulating e.m.f. in the induction coil. As the circuit between the two lines is closed by the switchboard cords, this e.m.f. excites electric waves which oscillate backward and forward around the circuit. To secure the best results it is evident that the winding of the receiver coil must be such as to appropriate and transfer to the magnet on which it is placed as large an amount as possible of the energy impressed on the line by the transmitter.

In dealing with alternating currents, particularly with those of as high frequency as telephonic waves, the operation of inductance and capacity becomes of far more importance than that of mere ohmic resistance, and must in the design of apparatus be treated with corresponding consideration. The ohmic resistance of the line is divided between the coil of the receiver, the windings of the induction coil, the line wire, the various connections and other miscellaneous apparatus distributed over the circuit. Similarly each part of the circuit is endowed with its portion of the inductance and capacity of the whole. It is easy to measure with a suitable dynamometer the e.m.f. at the terminals of the transmitter or even

FIG. 10.—DIAGRAM OF CONNECTIONS OF TWO JOINED LINES.

to calculate it as will subsequently be explained. If the maximum value of this e.m.f. be represented by E, the total resistance, inductance and capacity of the circuit respectively by the symbols R, L and C, and the number of waves per second of time by n, it is easy to show * that the resulting maximum current, I, is expressed by the formula:

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi n L - \frac{1}{2\pi n C}\right)^2}}$$

It can also be shown that the current wave may either lay behind or be in advance of the e.m.f. wave depending on whether $2\pi n L >$ or $< \frac{1}{2\pi n C}$ for the algebraic sum of these quantities is the tangent of the angular relation of the current and the e.m.f. that produces it. The quantity $2\pi n L - \frac{1}{2\pi n C}$ is known as the *reactance* of the circuit, and manifests itself as an opposition, and a very serious one, to the establishment of a current under the action of a varying e.m.f. As telephonic apparatus deals largely with coils of wire and magnets, whose capacity is very small, the portion of this formula, $1/2\ \pi\ n\ C$, may oftentimes, with sensible accuracy, be neglected, and the expression simplified by writing,

$$I = \frac{E}{\sqrt{R^2 - (2\pi n L)^2}}$$

* Alternating Currents, Bedell & Crehore, p. 150.

In this formula, $\sqrt{R^2 - (2\pi n L)^2}$ is called the *impedance* of the circuit. It opposes the passage of the current in a manner that closely resembles the barrier offered by the more familiar "ohmic resistance" and is often expressed as equivalent to so many ohms. Ohmic resistance, however, operates to destroy, or degrade a portion of the electrical energy, and change the same irrecoverably into heat, which is radiated away from the circuit. But inductance and capacity, while they absorb energy, retain and store it, the one in the magnetic field which is created about every conductor through which a current passes, and the other in the form of a charge or portion of electricity that seems to adhere, so to speak, to the surfaces of the conductors, and at the proper time the energy thus retained both magnetically and by capacity may be recovered. It is this property of giving up absorbed energy that causes the current to either lag behind, or advance before the propelling e.m.f.

There are two other exceedingly important deductions to be derived from the formula. In the quantity termed reactance, $2\pi n L - \frac{1}{2\pi n C}$ the factor, "n" enters. This is the number of waves per second. Now speech consists of a great many different waves, varying very greatly in speed. If n increases, the reactance will increase; that is, there will be a much greater opposition to the transmission of quick waves than to slow ones. This is the explanation of the fact that *ceteris paribus*, a bass voice can be heard better over telephone lines than a high, shrill one. Furthermore, it is evident that in any voice the high, shrill tones will, from this cause, suffer greater obliteration than the lower fundamental; hence the distortion that is noticeable in all telephonic transmission, and the reason why the letters, *s* and *c*, particularly, and *b*, *p*, *t*, etc., are with difficulty distinguished. If we examine the quantity, $2\pi n L - \frac{1}{2\pi n C}$ still further it is seen that $\frac{1}{2\pi n C}$ is negative, and the thought at once occurs to so design apparatus as to make $\frac{1}{2\pi n C}$ equal to $2\pi n L$, and thus neutralize inductance with capacity. In other branches of electrical engineering this method is practiced with great success, and this principle is the basis of Dr. Pupin's invention for improving transmission over cables and aerial lines. In the line that portion of the reactance due to capacity, namely $\frac{1}{2\pi n C}$, is much greater than that owing to inductance, $2\pi n L$. So in the Pupin loaded conductor additional impedance in the shape of coils of wire are inserted at frequent intervals for the purpose of balancing the capacity, and the test of practice shows that conversation is equally transmitted over a loaded conductor that is five times as long as an unloaded one. But in telephony one deals simultaneously with vibrations differing very widely in number, and the quantities themselves are exceedingly minute, both as regards e.m.f. and current. Thus Mr. Kennelly cites some experiments showing that .000000044 amp. can produce an audible sound in a receiver. This is about equivalent to saying that the energy expended by a weight of one grain falling one inch could keep a receiver sounding for two and a half years. Other investigations show results that are practically concordant. It is exceedingly difficult to deal with quantities so minute, for the possibilities of the unknown, and the present unknowable are vastly greater. For example, any mechanic can, on any lathe, turn up a bridge pin six inches in diameter to fit an eye bar, within a few thousandths of an inch. The pin is tossed on a freight car, rolled down a sandy embankment at the bridge site, and driven home in its place in the chords with never a thought of its gritty condition. But take a watch pinion possibly but one or two-thousandths of an inch in diameter. The error of a millionth of an inch is fatal. The kick of a fly's foot may bend it, and a grain of dust that even a sensitive eye could tolerate can arrest its motion.

To deal with a transmission plant reckoning voltage by tens of thousands, and amperage by hundreds is doubtless difficult, and taxes engineering science to the uttermost. But at the other extreme when the pressure and current become so small that the most analytic mind cannot grasp their minuteness, calculation fails, and only the cut-and-try method of experiment remains. Nevertheless, even if

telephonic magnitudes are so small as to elude the clutch of mathematics, electrical principles apply as a guide with as much force to telephone circuits as to any others, and it is certain that apparatus designed along well-known electrical lines is much more likely to succeed than any haphazard heterogeneous concatenation of apparatus thrown together by the accident of ignorance. For example, the line has for a quarter of a century remained unimproved. Now, owing to the suggestion of Dr. Pupin, transcontinental telephony is assured, and transoceanic telephony within grasp. Yet Dr. Pupin is a mathematician, pure and simple, and the problem was solved at the desk and in the laboratory and not in the field. We may, therefore, be quite certain that all improvements in telephone apparatus will follow definite electrical laws, and that those who are quick to perceive them will be the first to design the better types so ardently desired.

From the preceding formula it is seen that with a given varying e.m.f. the current from instant to instant varies with the reactance. By the laws of the electro-magnet we know that the rate of change in the magnetic field produced by a coil of wire carrying a current will be proportional to the number of ampere-turns. Ampere-turns may be increased by either augmenting the amperes, or the turns, or both. But to increase the turns in any coil to which a given e.m.f. is applied is to decrease the amperes, by augmenting the impedance of the circuit, and the problem is to determine the dimensions of the coil which will give the best result. That portion of the impedance due to ohmic resistance may be decreased by using a large wire of low resistance. This means a bulky coil of large radius, to hold heavy wire. Now the inductance of any coil is proportional to the square of its radius and the square of the number of turns, while the ohmic resistance is proportional to the radius and the number of turns. From the formula it is evident that the current will be a maximum when the denominator is a minimum, and as L varies as the square of the same quantities (the radium and number of turns of the coil) with which R varies directly, it is evident that the denominator will be a minimum when $R = \sqrt{2\pi n L}$, but space considerations will usually preclude putting this theory into practice.

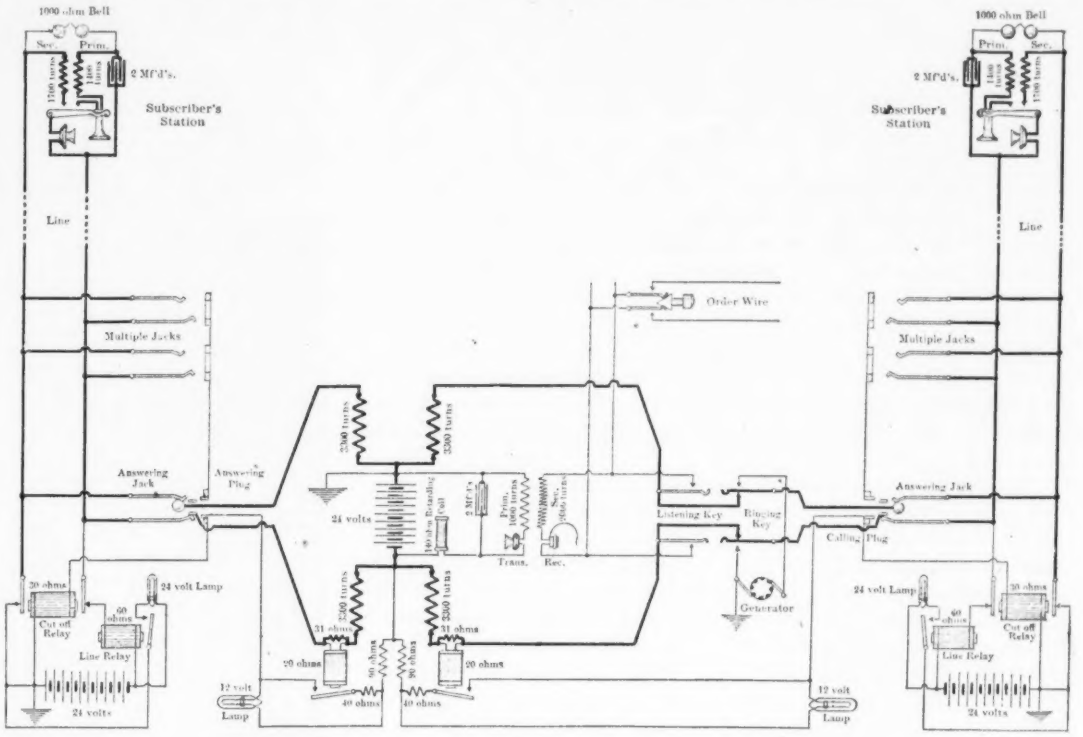


FIG. 11.—DIAGRAM SHOWING CIRCUIT OF SUB-STATION, COMMON BATTERY SYSTEM.

Not only does impedance reduce the total current that traverses a circuit on which an undulating e.m.f. is impressed, but it operates to prolong the time occupied by the current in reaching its possible maximum value. We are so accustomed to think of all electric action as being instantaneous, that it is hard to realize that every tick of a telegraph sounder, and every vibration of a telephone diaphragm requires a certain very measurable though minute period of time for its accomplishment, and whenever impedance is added to a circuit, the "time constant" or interval required by the current to reach its (approximately) full value is increased. It is easy by a formula given by Helmholtz to calculate the current in such a circuit at any interval of time after the e.m.f. has been applied. Suppose i be the current, t seconds after the application of the e.m.f., then

$$i_t = \frac{E\left(1 - 2.7183^{\frac{Rt}{L}}\right)}{R}$$

in which E R and L have the same meaning as before. It is evident by inspection that $\frac{E}{R}$ will always be reduced by the value of the quantity inside the parenthesis, and hence the current will theoretically never cease rising. Practically, however, it attains a value sensibly equal to the theoretical amount in a very small interval of two or three minutes may sometimes elapse. As L enters into the parenthetic coefficient, it is evident that the time constant will vary with L, and will also be proportional to the square of the number of turns and the radius of the coil.

To calculate the impedance of a circular coil in air is not difficult, but when the complications of an irregular shaped space, occupied by wire with an indefinite thickness of insulation, the insertion of an iron core of unknown permeability, and the addition of a permanent magnet of uncertain strength, an accurate calculation becomes impractical. By winding the coils in several sections connected in parallel, some advantage is gained. The ampere-turns are decreased directly as the number of coils, while impedance is reduced as the square of the number of turns is decreased. For example, if the two coils with which receivers are usually supplied be joined in parallel the ampere-turns are reduced one-half, for half the current will flow through each coil, but the impedance will be diminished to one-fourth, for there are only one-half as many turns on the line. There is, therefore, a decided decrease in reactance by winding the coils in sections joined in parallel. Several wires on one spool serve somewhat the same end, but with very small wire the proportion of time; although with the large field magnets of dynamo machines, the total coil bulk occupied by insulation is so great compared to the volume of copper, that this plan soon ceases to be of advantage.

The capacity of receiver coils is even under the most adverse circumstances very small, so small as to be almost negligible compared with the relatively enormous inductance. What little capacity there is probably of advantage in balancing to some extent the inductance. In this respect improvement in receiver design is likely to take the shape of the addition of more capacity to neutralize more perfectly the inductance, than any attempt to reduce that which already exists.

Some attempts have been made in the direction, but were never carried to any decisive conclusion. This certainly seems a promising direction for the ambitious inventor, and deserves to be explored.

Considering all these diverse elements, it is exceedingly difficult to arrive theoretically at the best size, shape, wire gauge, resistance and number of turns for receiver coils. Practical experience seems to have settled down to making the spools about .90 in. long., .45 in. wide, and .50 in. deep for the ordinary hand receiver, and .70 in. long, .30 in. wide, .40 in. deep for a head receiver. The very best single silk-covered wire is used and great care taken with the winding to pack the wire as closely and tightly as possible on the spool. The end of the winding of each spool is reinforced by a few inches of relatively heavy wire, say No. 28 to 30, to guard against rupturing the coil during the operation of assembling. Local battery or high-

resistance receivers are usually wound with from No. 34 to No. 40 wire to a resistance of 100 to 125 ohms. Some few makes carry the resistance to 175 or 200 ohms, but such instruments are rare. Low-resistance receivers, or common battery instruments, are usually wound with from No. 32 to No. 36 wire, and have a resistance of 40 to 60 ohms. Some are made as low as 25 ohms and some as high as 80, but these again are the exceptions. The spools should be made of some non-metallic substance like fibre or rubber, but if of metal should be laminated to prevent eddy currents. When complete the coil should be thoroughly impregnated with a non-hygroscopic insulator like shellac or paraffin, and covered with moisture-proof varnish or tape.

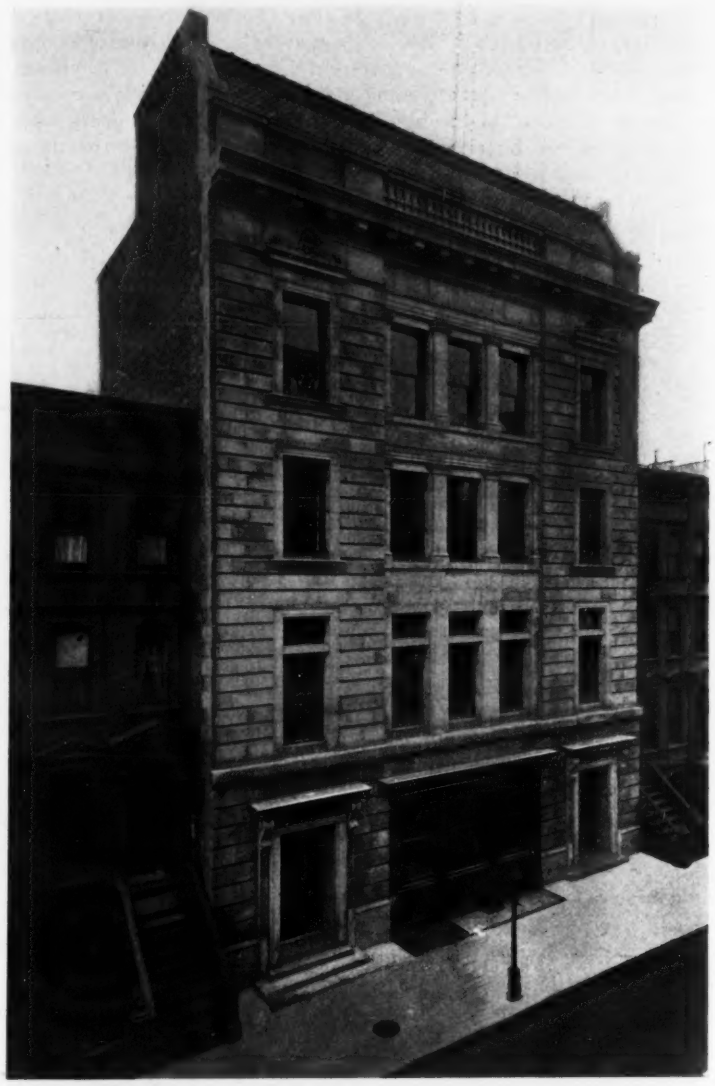
The New York Electrical Society and Transportation Problems.

At the 234th meeting of the New York Electrical Society, held in this city last week, Mr. Bion J. Arnold, consulting engineer to the New York Central Railroad and the Chicago City Council, gave an interesting illustrated address on the subject of the transportation problem in Chicago and other great cities. This address, accompanied by a large number of lantern slides of maps, curves and tabulated data, as well as of overhead and subway systems of operation, was based upon the valuable and exhaustive report which Mr. Arnold submitted a few months ago to the Chicago City Council, in order to assist the city to arrive at some basis of agreement with the street railway companies operating in that city. This report has already been elaborately discussed and analyzed in our pages, and need not therefore be taken up again in extenso. The address was a swift and masterful presentation of the wonderful mass of data dealing with the unification of the street railway service, either under single control—which was preferable—or by the co-operation of several systems, each under their own management. Mr. Arnold also went into a discussion of the relative increase of population and of traffic and surveyed the growth of the great cities here and in Europe for a hundred years past, in order to show the rate at which our newer centers of population might be expected to increase, and what would be the resulting necessities for street railway extension. Mr. Arnold, in his lecture, also considered the question of one fare for one city, the important subject of transfers, terminals, looping, underground and overhead net-works, and other features pertinent to the subject. In conclusion he pointed out that each city constituted a distinct problem, and that what might be desirable and even necessary for Chicago would not be at all applicable in New York or Boston. There was no discussion of the paper as the hour was late, but Mr. Frank J. Sprague, in a neat little speech, moved a vote of thanks, which was enthusiastically carried.

Prior to the lecture of the evening, an animated discussion took place in regard to some proposed constitutional amendments, the result of which would be to permit an extension of the present presidential term of one year, and which also made certain changes in the constitution of the nominating committee each year. The amendment brought forward had been prepared by the present executive committee, but it was soon evident that the membership in general, as represented by the audience, was very much against any change which would increase the length of the presidential term, or give undue power to a president in appointing a nominating committee. The sentiment in this respect was voiced very vigorously by Mr. Francis Forbes and Mr. Charles L. Eidlitz, both of whom from different points of view, insisted that the best interests of the society would be served by a rule rendering a president ineligible for immediate re-election. Mr. Forbes took up the subject along constitutional lines and gave notice of his intention to pursue the subject further in that manner at later meetings. Mr. Eidlitz, in a forcible but humorous manner, dwelt upon the large amount of excellent available presidential timber to be found in the Society, now 600 strong and growing rapidly, and showed that if they were only to get a new president once every two years, but twenty-five could enjoy the honor in the next fifty years, which would give no show at all to a great many men in the membership upon whom the distinction could be worthily conferred, with consequent stimulation of interest in the welfare of the Society and the bringing to bear upon its affairs the thoughtful activity of a greater number of well-trained minds from different branches of the industry. These views and others of like nature were heartily applauded by the audience, and the amendments as presented from the executive committee were promptly tabled.

New "Plaza" Exchange of the New York Telephone Company.

The latest addition to the exchanges of the New York Telephone Company is that known as the "Plaza," and which is here shown. It is a fine building of fire-proof construction, located at 110-114 East Fifty-eighth Street. The Plaza district, it is interesting to notice, is made up of portions of the old Thirty-eighth and the Seventy-ninth Street districts, and the transfer of the lines to the new central was accomplished with the utmost smoothness and celerity, and without any interruption of the service. The latest type of central energy switchboard has been installed. The statistics of the switchboard are given in the above table.



VIEW OF EXTERIOR OF PLAZA EXCHANGE.

a.—Ultimate capacity subscribers' lines		9,600
	Ultimate capacity incoming trunk lines	720
	Ultimate capacity outgoing trunk lines	600
b.—Present equipment subscribers' lines		5,600
	Present equipment outgoing trunk lines	360
	Present equipment incoming trunk lines	480
	Subscribers' lines now in service	3,111
	Subscribers' stations now in service	4,893
	Outgoing trunks now in service	247
	Incoming trunks now in service	290
c.—Number of operators now employed:		
	Day force	68
	Evening force	21
	Night force	15

Party-Line Telephone Service Before the Chicago Electrical Association.

An enthusiastic telephone meeting of the Chicago Electrical Association was held on May 1. A large number of men interested in that branch of the business, both from a commercial and from an engineering standpoint, were present, and the president of the Association called attention to the fact that Chicago, geographically speaking, was at the center of the telephone business. The meeting was semi-social in character, being held at the Albion Café.

Mr. H. P. Clausen, Chief Engineer of the American Telephone Company, was the principal speaker of the evening, and discussed the "Development of Party Line Telephone Service During the Last Ten Years," the subject receiving consideration with reference to the earliest attempts at operating party-line systems, and with particular reference to the developments in this line of work during the past ten or twelve years.

Reference was made to the original series arrangement—party-line systems in which all telephones were connected in series upon a line—and attention was drawn to the evil effects observed by reason of telephone currents being required to pass through the ringer magnets connected into the circuit. Several plans were referred to in which the matter of talking through the ringer magnets was overcome by supplying a separate calling wire, one being used for talking and another for signaling purposes. In connection with this system, reference was made to several attempts to provide lock-out devices, that is to say, the call-wire circuit was provided with a step by step electrically-operated mechanism for either shunting out all stations but the one wanted, or cutting in only such stations as might be wanted, and after this cutting in or shunting out had been effected by sending the proper number of impulses of current over the call wire, the station would be called by projecting signaling current over the talking wire.

Reference was further made to the system in which each station is provided with a low reading ammeter arranged with contact points at the different scale reading points. The needle of the ammeter formed one side of the signaling circuit and the contact point the other, this permitting of placing a certain amount of current upon the line, and through the ammeter needle making connection with the contact point, establishing the signaling circuit.

Further reference was made to the development of the bridging system. Plans were shown for permitting the use of signaling telephones over long lines.

The plus and minus system also received considerable attention, particularly in respect to showing its operating principles and the difficulties encountered in attempting to apply the plus and minus system to the present universally-adopted common battery swtichboard system. Attention was drawn to the impracticability of operating the bells when condensers were connected in series with the arrangement.

Next, attention was given to the high and low frequency selective signaling system invented by Mr. O. M. Leich, and placed upon the market by the American Electric Telephone Company, of Chicago.

The high and low frequency system was gone into thoroughly as to its method of operation and the apparatus which was provided was used for demonstrating the different points made by the speaker. Actual experiments made demonstrated the great working margin of the system, it being possible to project a current over the line to which several telephones were connected without affecting either the low or high frequency station equipment. That is to say, the low frequency station equipment was adjusted to operate on a 20-cycle current, while the high frequency operated on 60 cycles, and upon projecting a 40-cycle current neither bell would respond, but upon reducing the frequency to about 30 cycles, the low frequency bell responded, and upon increasing the frequency to approximately 50 cycles, the high frequency station would respond. At the same time, while projecting the 40-cycle current it was possible to produce a signal on the low frequency equipment by reducing the impedence of the coil connected in series with this equipment, and the high frequency equipment would be operated by increasing the impedence of a coil connected in parallel with the ringing equipment.

The discussion following the talk was interesting, as it brought out a number of valuable suggestions: Mr. W. F. Gradolph drew attention to the difficulties he encountered in maintaining the plus and minus system in working condition in actual practice, while Mr. M. W. Zabel discussed the developments of the high and low frequency equipment. Mr. C. Roth made a brief reference to the construction of the high and low frequency selective signaling machinery, Mr. Roth's company having supplied the very complete machine used by the speaker for demonstration purposes. Mr. Carl Kinsley, of the University of Chicago, described the application of resonance effects, and called attention to the fact that in the case of long lines, a change in current caused by a change in frequency is not rapid enough to make it possible to operate more than two selective ringing devises on the same line. This system can be used practically only in the case of very long and expensive lines, as the expense at each station is so largely increased.

Mr. Christ, of the Stromberg-Carlson Company, and Mr. Ames, of the Kellogg Switchboard and Supply Company, were called upon to give the Association some information in respect to selective signaling systems, which are being prepared by their respective companies, but begged to be excused, stating that patent papers being prepared by the companies were not in such condition as to permit publishing anything at this time.

Financing the Yerkes London Underground.

At the close of last week the banking firm of Speyer & Co. announced that they had formed a syndicate to float here half of the $30,000,000 loan required to build the Yerkes-Speyer London rapid transit tube. This loan will be in the shape of ten-year 5 per cent. gold notes issued by the Underground Electric Railways Company, of London, Limited. The Old Colony Trust Company, of Boston, is also in the syndicate. The London end of the deal will be managed by Speyer Brothers & Co.

The capital will be £5,000,000 ($25,000,000), of which 50 per cent. has been paid in, the remaining 50 per cent. being subject to call. The articles of association provide that for a period of ten years the majority of the Board of Directors shall be named by Speyer Brothers, of London; Speyer & Co., of New York, and the Old Colony Trust Company, of Boston. The first board of directors will consists of the following: James Speyer, T. J. Coolidge, Jr., James A. Blair, James H. Hyde, L. F. Loree, Robert H. McCurdy, Charles A. Spofford, the Right Hon. Lord Farrer, Major Ernest St. Clair Pemberton, Walter Abbott, Frank Dawes, Charles J. C. Scott, Edgar Speyer, Henry Teixeira de Mattos. Charles T. Yerkes will be chairman of the board.

The policy of the company probably will be to control different companies through traffic agreements and ownership of securities, or both, the bulk of the actual capital to defray the cost of construction of each of the roads being obtained through the sale of guaranteed securities of the subsidiary companies, the interest or dividends being guaranteed by the parent company.

The capital of the parent company is necessary to finance the subsidiary companies until their respective securities have been marketed, and to give the proper stability to the parent company in order to make it a satisfactory guarantor company. The surplus earnings, over and above the guaranteed interest and dividends, on the sub-company securities will constitute the chief source of income of the parent company. Another source of income will be in the ownership of ordinary shares obtained through the profit of construction of sub-companies.

The new company now controls the Metropolitan District Railway, which is a shallow subway and surface road, owning its right of way in fee. In addition the new company is building three deep level tube roads, namely the Baker Street and Waterloo, Great Northern, Piccadilly and Brompton, and the Charing Cross, Euston & Hampstead. It also controls the United Tramways Company, with many miles of surface roads running in a general westerly direction from around Shepherd's Bush and Hammersmith.

Of the Metropolitan District Railway over one-half of the ordinary stock will be, on the completion of the work under way, owned by the parent company, and the voting power of a large amount of the

preference stock has been secured under a guarantee. The guarantee begins at 1 per cent. per annum the first year on the deposited stock, and runs up to a limit of 3½ per cent. after some six years. Surplus earnings above the guaranteed amount go to the parent company. This railway is now being electrically equipped. It is expected that this work can be finished before the end of 1904.

In this connection, it is interesting to note that the electrification of the London transit systems, which promises to absorb a great quantity of money, had a very important condition imposed last week by the Parliamentary committee which is empowered to grant the franchise. This committee has rejected the application for a franchise of the Northeast London Railway, which proposed to serve 2,000,000 people and was supported by the trunk lines which traverse that district. The rejection was because the backers of the company had not the financial strength to guarantee to the committee that they would carry the scheme through, commencing the building of the road at once and continuing the work uninterruptedly until its completion. The committee added that in all future London traction schemes it must have evidence of full financial guarantee before engineering and local questions will be considered.

A cable dispatch from London of May 4 says: The Yerkes-Speyer scheme for the consolidation of all the underground tube railways of London is meeting with considerable opposition. The newspapers protest against such "Americanism" and monopoly, and urge Parliament not to submit thereto. The Parliamentary committee of the London County Council will submit its report to the council to-morrow. This report will insist upon a further investigation of the consolidation scheme, which, the committee contends, will raise fares and otherwise operate to the disadvantage of the traveling public.

New Telephone Patents.

Probably few telephone men have considered the difficulties of maintaining telephones of the ordinary design in a state of high efficiency, where continually subjected to a corrosive atmosphere. The salt air and spray found on shipboard forms such a corrosive atmosphere, and one which will soon rust ordinary instruments into a state of comparative uselessness. Mr. F. A. Wood, of Newport News, Va., has endeavored to overcome this difficulty by a special design of instrument which he has described in two patents of the issue of April 28. Mr. Wood's apparatus seems to be fully and carefully worked out and to provide not only against corrosion, but also, through the provision of a double ear tube, to render of little effect extraneous noises liable to disturb the listener.

This apparatus has been worked out in two forms. These are alike in principle and one of them is shown in section in Fig. 1. As will be readily observed, both the transmitter and receiver are contained wholly within a protecting case. This case is cylindrical in form and has an opening in one side, which has the shape of the outer portion of a transmitter mouthpiece. A tubular shaft extends through the center of the cylinder to which not only the double ear tubes are attached, but also both receiver and transmitter. In the normal or disused position, the ear tubes extend downward from the shaft, and being of semi-flexible construction, are made to clamp the supporting frame in a manner to be completely closed by it. This closing of the tubes is rendered very positive, as the rims of the ear pieces consist of rings of soft rubber.

With the instrument in this condition, the mouthpiece opening is also closed, this not only by a manually operated lid, but also by a plate of metal shaped to conform to the enclosing cylinder and held over the opening by the position of the hollow shaft to which it is secured. It will also be noted that the receiver and transmitter revolve with the hollow shaft, being integrally connected with it.

Now, when it is desired to use the instrument, the ear tubes are swung into a position somewhat higher than the horizontal, which motion carries the sliding spring contact pins, shown in the casting beneath the receivers, into the position indicated by the dotted lines, where they not only perform the usual contact functions of the hook switch of ordinary practice, but in addition drop into depressions indicating thereby that contact has been accomplished. At this time the transmitter has also been revolved into the position indicated by the dotted lines, its mouthpiece registering with that of the casing. As the ear tubes are semi-flexible, it is easy to adjust them upon the head to cover both ears and, as before mentioned, exclude extraneous sounds. A further feature of the apparatus is the proportioning of the parts such that as soon as the ear tubes are released, they will return to the normal position by their own weight. This not only seals the instrument automatically, but revolves the sliding contacts away from their contact plates and opens the telephone circuits.

A third telephone patent of the April 28 issue describes a transmitter which is designed to have extraordinary sensitiveness, and in which novel means are employed to prevent packing of the carbon granular filling. This transmitter is shown in section in Fig. 2. The

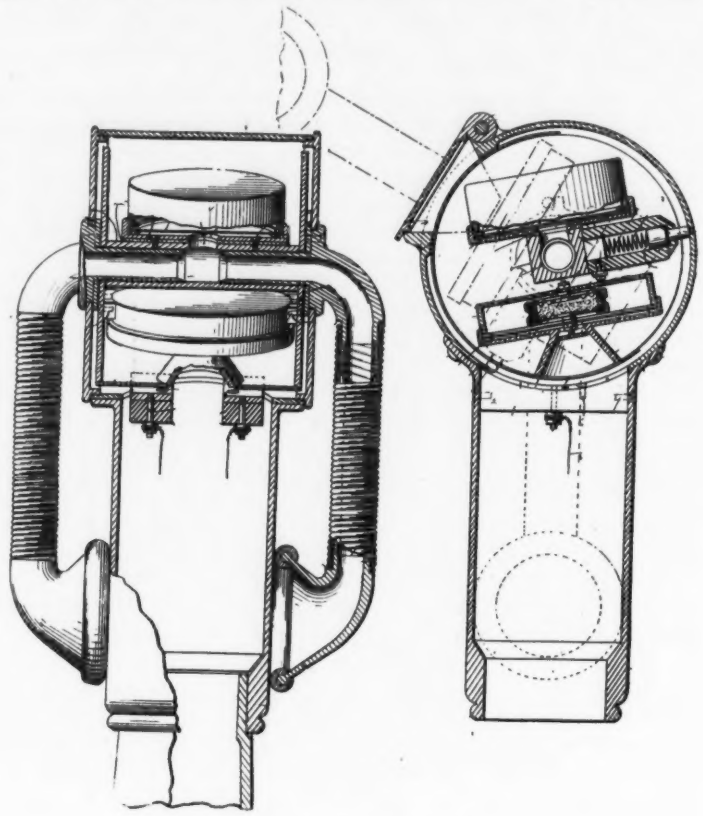


FIG. 1.—WOOD TELEPHONE.

diaphragm is of carbon and is supported upon a pad consisting of superimposed perforated discs of flannel. These form the button casing, at the rear of which a back electrode is mounted shaped as indicated in the figure, and carrying at the flared end of the cone a cross-bar. This cross-bar is normally in a horizontal plane, and its rear edge is cut away at the middle. Now, when the diaphragm is under vibration, its inward motion tends to force granules up toward the apex of the cone and over the cross-bar, while at the outward motion of the diaphragm the increasing space is largely

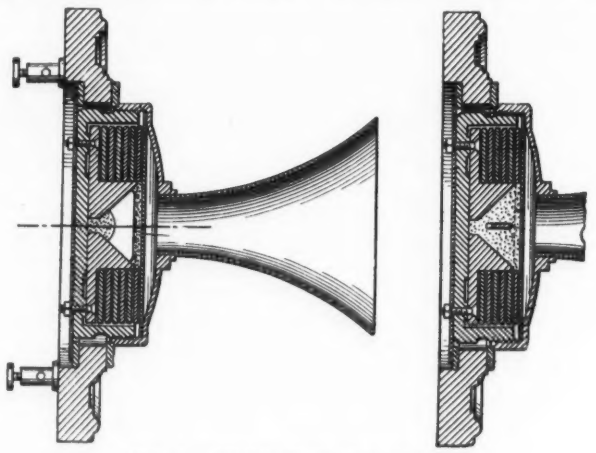


FIG. 2.—SENKBEIL TRANSMITTER.

filled with granules from above. This results in a circulation of the granules. It cannot be stated just how effective such a circulating device will be in practice. The long-distance transmitter of the Bell Company, which had a device of very similar principle, has long since been superseded by a transmitter without any obstructions in the carbon chamber. The present transmitter is the invention of F. W. Senkbeil, of Germany.

Statistics of American Street Railways.

We present herewith the statistics of the street railways of the United States, in a preliminary report given to the press on May 4 by Mr. W. M. Steuart, chief statistician of the Division of Manufactures, U. S. Census office, to Director W. M. Merriam. The figures are for the year ending June 30, 1902, and are the first results of the inquiry which has been conducted under Mr. Steuart, with Mr. T. C. Martin and Prof. E. Dana Durand, as experts and special agents in charge of the work. The report, when finished, will be a most elaborate and careful compilation, with running comment of the figures of the street railway industry. It may be noted that the mileage does not include a considerable quantity that was under construction during the year covered by the report. The agents were instructed to secure reports from railway plants that were in process of construction, but a number of plants had only just commenced work. Others had constructed one or two miles of track. In cases where the work had only started, of course, no return could be obtained. Hence the schedules as to track under construction or contemplated are not summarized.

Street and Electric Railways.

Number of companies	967
Length of line (first main track) miles	16,647.83
Length of single track, miles	*22,589.47
Total number of cars	67,199
Passenger	60,200
All other	6,909
Steam engines:	
Number	2,337
Total horse power	1,293,133
Dynamos for generating power:	
Number	3,257
Horse power	1,200,138
Number of fare passengers carried	4,813,466,001
Number of transfer passengers carried	1,062,403,392
Total mileage	1,097,806,884
Accidents:	
Persons killed	1,216
Persons injured	47,428

* Includes 12.48 miles of duplicated track and 4.20 miles lying outside of the United States, but does not include track under construction and not operated.

Condensed Income Account, Operating Companies.

Earnings from operation	$241,584,697
Operating expenses	139,012,004
Net earnings	102,572,693
Income from other sources	2,907,156
Gross income less operating expenses	105,479,849
Deductions from income, taxes, interest, rental, mis.	74,524,616
Net income	30,955,233
Dividends	15,908,216
Surplus	15,047,017
Percentage of operating expenses to earnings	57.54

Balance Sheet, All Companies.

Assets:	
Total	$2,428,317,117
Cost of construction and equipment	2,088,965,677
Other permanent investments	128,458,625
Cash on hand	27,342,313
Bills receivable	22,247,704
Supplies	10,340,448
Sundries	150,964,350
Liabilities:	
Total	$2,428,317,117
Capital stock	1,216,277,989
Funded debt	929,328,656
Bills and accounts payable	94,858,371
Interest due	13,748,010
Dividends due	2,342,827
Sundries	130,589,472
Profit and loss	41,171,792

Average Number of Employees and Salaries and Wages.

Salaried officials	2,749
Salaries	$4,625,015
Clerks	4,301
Salaries	$2,575,936
All other employees	131,133
Wages	$77,437,324

The final report will contain an analysis of the above totals and present detailed statistics for other phases of the industry. While the statistics reported at the census of 1890 are not comparable in all respects with those for 1902, the totals indicate that, during the twelve years, the length of line has increased from 5,783.47 miles to 16,647.83 miles, or 187.85 per cent.; the length of single track miles from 8,123.02 to 22,589.47, or 178.09 per cent; the number of passenger cars from 32,505 to 60,290, or 85.48 per cent.; the number of fare passengers carried from 2,023,010,202 to 4,813,466,001, or 137.94 per cent. The miles of single track operated by electric power increased from 1,261.97 to 21,920.07, or 1,636.97 per cent.; the miles operated by animal power decreased from 5,661.44 to 259.10, or 95.42 per cent.; the miles operated by cable from 488,51 to 240.69, or 50.71 per cent.; and the miles operated by steam from 711.30 to 169.61, or 76.15 per cent.

The statistics for equipment, exclusive of length of track and number of cars, do not include two companies with 41.00 miles of single track, who failed to make reports of any character. The financial statistics do not include nineteen companies with 739.79 miles of single track, who failed to answer the inquiries concerning financial operations.

Stealing Electricity in Mexico City.

A Mexico City hotelkeeper has just been convicted by a local judge for stealing from the electric light company the current with which his hostelry was lighted. He was condemned to a year's imprisonment and a fine of $33.70, and as an additional penalty was "disqualified for all kinds of public honors and employments." The landlord who attempted to evade the electric company's charges wired his house and made a connection with the company's cables, with the intention, as he pleaded, of calling at the office of the company and explaining the matter at a later day. He also declared that he had used the current for "only a month." The company had its suspicions aroused, and applied to the court for authority to make an examination of the hotel lighting system, which was granted, with the result of revealing the fraud. The legal point of interest involved in the case hinged upon the definition of the word "robbery," which the district code thus elucidates: "He commits robbery who possesses himself of a moveable thing belonging to another, without right and without the consent of the person entitled by law to dispose of it." The judge's ruling was as follows:

"By things or properties (for in legal phraseology these two words are synonymous) are understood all the objects that constitute the patrimony of man; and if it is plain that electricity, whether it be called a fluid, a current, an energy or any other name, at present forms a part of human wealth; that, thanks to the prodigious progress of the times and to his own activity, man has succeeded in harnessing it and using it as a commercial article; it is unquestionable that the electric current forms part of men's commerce, and is, therefore, capable of being appropriated; and as it is also unquestionable that this fluid can be transmitted and transported from one place to another; whatever the means employed to that end, it must also be regarded as a moveable thing; and, therefore, there will assuredly be no difficulty in allowing that the clandestine tapping of the fluid constitutes the crime of robbery as it fits exactly the terms of the legal text which comprises and defines it."

In view of the summary punishment inflicted in this, the first case of the kind which has come before the courts of Mexico, it is believed that the "thing" dealt in by the electric light companies, the illuminating current, to wit, will hereafter be carefully avoided by individuals who desire to economize at the expense of others.

Electrifying the Swiss Railways.

The railway system of Switzerland is likely to undergo a mighty transformation. At a convention of representatives of Swiss railway lines and the prominent technical experts of the state, lately held at Berne, the introduction of electric traction formed the object of deliberation. A special committee was appointed to investigate the subject in all its details and to report thereon next year and make proposals for adopting the most practical mode of applying electricity as the motive power for Swiss railroads. Ample funds have been supplied to the committee to enable them to make ample tests and to carry out the purposes for which it has been created. The director-general of the Swiss railroads (which belong to the State) was appointed chairman, and the manager of a prominent Swiss electrical company, vice-chairman of said special committee. Switzerland has no coal, but is rich in water power. This transformation would save the little republic many millions of money which it now pays every year to Germany for coal imported from there.

Programme of Papers for the N. E. L. A. Convention.

An excellent list of papers and topics has been prepared for the meeting at Chicago this month of the National Electric Light Association, and there is every evidence that an unusually large attendance will reward the officers and authors. The programme of papers is as follows:

"Fuel Losses in Furnaces and Boilers, and How to Lessen Them," Mr. A. Bement; "Salt as a By-Product," Mr. Alex Dow; "Advantages Derived from the Use of One System of Generation and Transmission in One Locality," Mr. C. L. Edgar; "Tactful Relations with Customers," Mr. J. W. Ferguson; "Relative Advantages of Electrical and Mechanical Methods at Variable Speeds for General Power Service," Mr. William Cooper; "First Aid Appliances," Mr. J. D. McGowan; "Standard Ratios for Transformers," Mr. John S. Peck; "Steam Turbines," Prof. William Lispenard Robb; "The Application of Four-Ampere Series Arc Lamps for Street Lighting," Mr. J. Henry Hallberg; "Some Fundamentals of Photometry," Prof. H. E. Clifford; "Exhibition and Description of the Matthews Integrating Photometer," Prof. Charles P. Matthews; "Attitude of Employer towards Benevolent Insurance and Educational Associations among Employees," Mr. Arthur Williams; "District Heating," Mr. John W. Glidden; "The Young Engineer and the Electric Lighting Plant," Mr. Charles F. Scott; Prof. Elihu Thomson.

The Committee reports to be presented are as follows: 1. Report of Editor of Progress, Mr. T. C. Martin. 2. Decorative and Sign Lighting, Mr. Arthur Williams. 3. Unaccounted for Current, Mr. L. G. Van Ness. 4. Theft of Current, Mr. R. L. Elliott. 5. Office Methods and Accounting, Mr. W. M. Anthony. 6. Photometric Committee, Mr. H. L. Doherty. 7. Committee on Analysis of Flue Gases, Mr. H. L. Doherty. The editor of Question Box, Mr. H. T. Hartman, who will present a large amount of valuable material for consideration.

CURRENT NEWS AND NOTES.

FORTY SECONDS is the time in which the Commercial Pacific Cable Company proposes to put a message around the world on July 4.

PACIFIC WIRELESS TELEGRAPHY.—The Pacific Cable Board is reported to be conducting negotiations for a series of wireless telegraph experiments between here and the Fanning Island cable station. Fanning Island is a station on the British Pacific cable from Vancouver to Australia.

TRACTION MUNICIPAL OWNERSHIP.—The Mueller traction bill, authorizing municipal ownership of railways, has passed the Illinois House of Representatives. This bill has been fought by the great traction interests of Chicago because it would confer authority on the city to take over various street railways when their franchises expire.

AN ELECTRIC SPRINKLER.—A cable dispatch from Paris of May 2 says: A leading engineer of Paris has invented an electric sprinkler which will water ten miles of streets an hour. It will be an automobile and will be able to water the Champs Elysees and the Avenue due Bois de Boulogne in fifteen minutes. The machine only costs $3,000. If it proves successful the city will ordere a large number.

IN AID OF ELECTRICITY.—A cable dispatch from Paris of May 2 says: The Institute of France has decided to divide the Lebrousse prize of $16,000 into four parts, one part to go toward the maintenance of the *Journal des Savants*, the second to the publishing of the memoirs of Richelieu and his agents, the third to the publishing of the works of Leibnitz, and the fourth to experimenting in electricity.

WESTERN UNION AND PENNSYLVANIA RAILROAD.—The Western Union Telegraph Company has filed a suit in the United States Court at Baltimore asking that the Philadelphia & Washington Railroad Company, a branch of the Pennsylvania Railroad, be enjoined from destroying the telegraph company's lines. The railroad company requested the Western Union to remove its wires and poles from the line of the road by May 15. This the latter refuses to do, and has asked for an injunction to prevent any forcible action on the part of the railroad company.

INSTITUTE ANNUAL MEETING.—The annual meeting of the American Institute of Electrical Engineers will be held on May 19, when the following is the programme: 1. Annual Reports of Officers and Committees. 2. Introduction, President Scott. 3. "The Experimental Basis for the Theory of the Regulation of Alternators," by B. A. Behrend, member, chief engineer Bullock Electric Manufacturing Company. 4. "The Heyland Motor," by C. A. Adams, Jr., associate, assistant professor of electrical engineering at Harvard University. Some very important announcements are also expected. The meeting will be preceded by the usual informal dinner at Mouquin's.

A LIEBIG CENTENNIAL.—The twelfth of May, 1903, being the centennial of Justus Liebig's birthday, a committee has arranged a celebration in memory of the illustrious investigator on that day, to which the members of the American Chemical Society, the Society of Chemical Industry, the American Electrochemical Society, and the Chemists' Club, are cordially invited. Prof. Ira Remsen, president of Johns-Hopkins University, and Prof. William H. Brewer, of Yale University, will deliver orations. Dr. C. Duisberg, vice-president of the parent society, Verein Deutscher Chemiker, and Prof. Charles F. Chandler, of Columbia University, will also address the meeting. The exercises will begin promptly at 8:30 P. M. in the assembly hall of the Chemists' Club, 108 West Fifty-fifth Street, New York.

STUDENTS' THESES.—The board of directors of the American Institute of Electrical Engineers has requested that the head of the electrical engineering department in each of the universities and technical schools in which local Institute meetings have been held during each year, be requested to select from the theses of each year's graduating class, the one which in his judgment is of superior merit and is a valuable contribution to electrical engineering work. Such theses will be submitted to an Institute Committee on Theses, which will select those of superior excellence, and designate to the board of directors which in its judgment are worthy to be printed in full or in abstract in the *Transactions* of the Institute. The theses to be presented to the Institute should reach the secretary not later than July 15th of each year.

SCIENCE AND RELIGION.—Lord Kelvin, in moving a vote of thanks to Prof. Henslow before the University College Christian Association in London last week, according to a dispatch printed in a New York newspaper, demurred to the professor's assertion that, with regard to the origin of life, science neither affirmed nor denied the creative power. On the contrary, he said, science positively affirmed the creative power. Science made every one feel that he was a miracle in himself. Modern biologists were once more coming to the firm acceptance of a vital principle. They had been absolutely forced by science to admit and believe in a directive power. "Was there," he asked, "anything so absurd as to believe that a number of atoms falling together of their own accord could make a crystal sprig of moss, the microbe of a living animal? Nobody could think that anything like that even in millions and millions of years could, unaided, give us a beautiful world like ours. Let nobody be afraid of true freedom of thought. Let us be free in thought and criticism, but with freedom we are bound to come to the conclusion that science is not antagonistic, but is a help, to religion."

WATER SUPPLY OF MILAN.—The water supply of Milan, Italy, like that of many American cities, is now being assisted by electric motors. In 1896 it was again found necessary to increase the production, and the pumps, which were then operating in Via Parini for supplying the fountain service in the public gardens, were connected with street mains for the supply of the houses in the vicinity. In 1901, being found unserviceable from long use, the pumps were replaced by a centrifugal of the Sulzer type, driven by an electric motor. A new well, also, was sunk to a depth of 197 ft. It produces 17 gallons of water per second, and is provided with a sand filter. The numerous demands for both public and private service caused a new plant to be decided on, and in 1899 it was finished. It consists of two pairs of double-action pumps of the Riedler type, each group being driven by a 75-hp electric motor, and produces 55 gallons of water per second. In 1900 four other Sulzer pumps, with electric motors, were placed at the Rondó di Loreto, on the outskirts of the city. This plant also furnishes 55 gallons per second from its eight wells.

NEW YORK-BOSTON TROLLEY.—The Connecticut House of Representatives has passed an important resolution incorporating the Wallingford Tramway Company. The charter provides for the building of the final link of a continuous trolley line between New York and Boston. The company is authorized to build from the terminus of the Meriden Electric Company's lines in Wallingford South, through North Haven to Montowese, where connections are made with the Fair Haven & Westville Railroad Company's system. The company is capitalized at $500,000. The charter carries power to make traffic agreements with connecting railroads, and it also gives almost unlimited authority of merger with gas, electric light, railway or power companies. The incorporators are Walter J. Leavenworth, Frank A. Wallace, George E. Dickerman, Charles B. Yale and Ralph T. Ives, all of Wallingford. The Senate, in concurrence with the House, has passed a resolution increasing the capital stock of the Windsor Locks and Rainbow Street Railway Company. The construction of this line will complete a through trolley road between Hartford and Springfield on the west side of the Connecticut River.

A MUNICIPAL OBJECT LESSON.—In 1899 the electrical experts in the employ of the London County Council showed that the cost of constructing and equipping an electric line between Westminster and Tooting and from Blackfriars to Kennington would be about £255,000, or £15,000 per mile. Fourteen months later, when the appropriation was applied for, the estimates had been advanced to £623,500; but now that it is completed the system is found to have cost nearly £1,000,000. Up to the present time the cost of transforming the lines controlled by the County Council has been about four times as much as the official estimate and about three times as much per mile as like work on other systems in Great Britain has averaged. The estimates of profits to result to the community from the change were based on the assumption that gross earnings would be 10½d. to 1s. per train-mile, and operating expenses 6d. On this basis it was figured that after paying interest and providing for additions to the sinking fund the electrified system would show a net gain of £53,618 in earnings over operation with horses. Lord Welby, chairman of the Finance Committee of the County Council, has now stated officially that there is an extremely good prospect in the near future of the Southern tramways becoming a charge upon the rates.

FIRES IN RAILWAY CARS AND BARNS.—Mr. William T. Bennallack, electrical inspector of the Michigan Fire Underwriters' Inspection Bureau, in a paper on the fire hazard in electric railway car houses, states that of 19 fires he has investigated, 7 were due to defective wiring, 3 to broken trolley wires, 1 was not electrical, and 7 were of unknown origin. Of the origin of 61 fires in cars, 25 were due to controllers and heaters, 13 to wiring, 4 to miscellaneous electrical causes, 1 was not electrical, and 7 were of unknown origin. He states that statistics clearly indicate that the greater part of the hazard exists in the cars, where 75 per cent. of the fires listed have started and the electrical equipment is responsible for more fires than all the other causes combined, 65 per cent. having originated from electrical sources. In the wiring in cars, car houses and repair shops, he finds that with few exceptions the 500-volt grounded street railway current is installed mechanically and electrically far below the standard found to exist in ordinary commercial wiring where the usual voltage is 125. In recently visiting the works of some of the representative car builders where he inspected the latest types of cars, he found the lighting and motor wires run in grooves in the framework, fastened in place with nails and metal staples, in contact with electric bell wiring of interior insulation, and with no insulating tubes of any kind through the woodwork, floors or vestibules of the cars. The general conditions, in fact, indicated an absolute disregard of the fire hazard.

METER PATENTS.—The Patent Office issue of April 21 contains three patents on wattmeters, two of which were issued to Prof. Elihu Thomson and F. P. Cox, and the third to Frank Holden, of London, England. The first-mentioned patents are on an adaptation of the Thomson wattmeter whereby a meter may be made to register at a rate varying from hour to hour, dependent upon the load upon the central station and in more or less direct proportion thereto. It consists in general of the ordinary recording wattmeter to which is connected a variable resistance; over the contacts of the resistance a switch arm is moved by a cam driven by clockwork mechanism, so that at the time when the least load comes upon the station the greatest resistance will be in circuit with the meter, which resistance will be decreased as the load comes on and decreased as it falls off. By varying the shape of the cam, this change may be made anything desired. In a lighting system where the peak of the load appears from 5 to 8 o'clock in the evening, the shape of the cam would be such as to cut out the resistance quite gradually, or if the load falls off more rapidly the shape can be adapted to compensating for this. The Holden patent relates to means whereby a meter will register not only the total consumption of energy, but also indicate separately the energy consumed above a predetermined rate. There are two registering trains, one of which is constantly in gear with the armature of the meter and another which is provided with means for automatically setting it in operation when the rate of consumption rises above the predetermined rate. This is done by a magnetic arrangement dependent for its action upon the field of the meter coils.

NEUTRAL WIRE BALANCER.—In a patent issued April 21 to Norman Rowe on an application filed June 18, 1897, a system of electrical distribution is described whereby a three-wire system may be locally derived from a two-wire general distributing system. Two motors are employed having their armatures on the same shaft, each of the motors being provided with a shunt and a series field winding. The third or neutral conductor is connected at one end to the armature of one of the motors and to the outer terminal of the series field winding of the other motor. When the loads are equally balanced, the two motors will run as differential motors and provide mechanical power. If, however, the load is decreased upon one side or increased upon the other, the machine connected across the more lightly loaded side will continue to run as a differential motor, while the other motor will run as a generator for the reason that the series coil of the latter is so connected as to cause the machine to over compound. The series coil of the machine running as a motor is so connected as to cause that machine to increase in speed under the increase in load. Consequently, by properly proportioning the series turns an approximately perfect balance of the voltage of the two sides may be obtained. It is stated that in practice the proportion of unbalancing which can be taken care of by such an arrangement, is equal to the combined rating of the two machines when used entirely to regulate their voltage, or to their combined rating less the power delivered to an outside system when the machines run partly as motors and partly for balancing purposes. It has also been found that this rating will maintain the voltages on both sides of the three-wire systems substantially equal when two motors are used partially for driving other machinery and partially for unbalancing purposes, no adjustment being necessary between the condition of no load and that of 50 per cent. overload.

LETTER TO THE EDITORS.

Hungarian Telegraphs and Telephones.

To the Editors of Electrical World and Engineer:

SIRS:—The book review appearing in your issue of January 31, 1903, on "Improvements in Hungarian Telegraph and Telephone Installations," contains several inaccuracies which I trust you will permit me to correct. This may perhaps be best done by the following statement as to the present service.

At present only the telegraph service is operated by dynamo currents, and the results during a period of two years of operation have been excellent. The current for 500 telegraph lines is supplied by a 2½-kw converter, but two others of the same size are held in reserve. These converters are supplied from the city alternating-current mains, but provision is made for utilizing direct current from the city mains should the alternating current supply be interrupted. To this end there is a 6-hp, direct-current motor, which may be connected to any one of the three rotaries. Finally, should the direct-current supply fail, a 6-hp gasoline engine is provided to replace the direct-current motor.

As generators there are thus three converters of 2.5 hp each, which may operate (1) as converters with alternating current, (2)

as dynamos with direct current, (3) as dynamos driven by a gosoline engine. It is doubtful if there is any similar telegraphic plant so well equipped with respect both to generators and motive power to meet any emergency that may arise.

As to reliability of service, I may say that during the period of two years' operation of the plant, no trouble has arisen, and it has not been necessary to resort either to the direct-current motor or gasoline engine.

With respect to the invested capital, the installation, which at present is only utilized to half its capacity, did not exceed in cost the cost of the Meidinger batteries displaced. The installation, indeed, has exceeded our most sanguine expectations with respect both to convenience and economy.

I may finally add that duplex and simultaneous working have fully stood the test, and owing to the satisfactory results obtained in operation, other similar installations will be made.

BUDAPEST, HUNGARY. P. DE SZALAY,
Director-General of Hungarian Posts and Telegraphs.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Large Three-Phase Alternator.—An illustrated description of a 6,000-hp alternator of 75 revolutions built by a German firm for the Manchester tramways. The outside diameter is 32 ft. 10 in.; the stator weighs 60 tons; the frequency is 100 periods per second. The method of erecting the alternator is described.—*Lond. Eng'ing*, April 17.

REFERENCES.

Dynamos and Motors with Vertical Axle.—An illustrated description of dynamos and motors with a vertical axle, built by a French company for turbine connection in certain hydroelectric stations.—*L'Ind. Elec.*, April 10.

Gramme Ring.—K. R. JOHNSON.—A brief but highly mathematical article on oscillations produced in a Gramme ring.—*Phys. Zeit.*, April 1.

LIGHTS AND LIGHTING.

Low-Voltage Carbon Incandescent Lamps.—WEISSMANN.—An article in which he claims that it is by no means necessary to give up the carbon filaments hitherto used in order to obtain a higher efficiency, but that the same result may be obtained by using low-voltage lamps. With 220 or 110 volts it is necessary to use extremely thin and long filaments for the usual candle-powers. In practice abrupt changes of temperature occur, owing to sudden variations of the voltage, and these thin filaments are especially sensitive to such variations. The higher the surface temperature of the filaments, the greater will be the danger of particles being projected, this danger being the only practical limit of the intensity of incandescents. The quantity of light, however, depends only upon the mean temperature; for a thin filament the mean and the surface temperature are practically identical, whereas in thick filaments the internal temperature will be much higher, the higher the thicker the filament. The external temperature, and, therefore, the danger of destruction thus being the same, the thicker filament has a higher efficiency, its internal temperature being higher. This is the explanation of the author, who also points out that this agrees with experiments of Elihu Thomson and Weber. The economizing system designed by the author and Blondel, consists in diminishing in a suitable way the voltage of the supply current at the point of consumption, and using lamps with thick carbon filaments. For example, a 100-volt, 100-candle filament may be divided up into five 22-volt, 20-candle filaments. The transformation is secured by inserting a very small transformer between the supply mains and each group of lamps lighted simultaneously An interrupter is placed in the primary circuit of the transformer, so that the latter, acting automatically with the corresponding group of lamps, will never work without load. It is said that in Paris several thousands of these lamps have already been installed, showing a saving as high as 40 or 60 per cent., as compared with high-voltage lamps.—*Jour. de Phys.;* Lond. *Elec. Rev.*, April 17.

Theatre Lighting.—A description of the electric lighting installation of the Chelsea Palace of Varieties in London. Electric light is used throughout, the current being supplied by two companies, one furnishing 100-volt, alternating-current, the other 200 direct-current. All lights throughout the whole of the auditorium and stage are so arranged that approximately one-half are in one company's mains and the remaining half on the mains of the other company. Liquid resistances are used for the dimmer, the cones being lifted by an arrangement of pulleys and "tracker wires" fixed on polished steel shafting and worked from the front of the switchboard by means of engine-turned iron wheels, with suitable locking gear for operating any dimmer independently or working the whole line simultaneously by means of the master lever. On the stage there is an equivalent of 1,600 incandescent lamps of 8 cp, in addition to four projectors and a cinematograph requiring 60 amp. The auditorium and shelter lighting consists of an equivalent of 1,000 incandescent lamps of 8 cp, and 8 arc lamps of 10 amp on the front. Lond. *Elec.*, April 17.

REFERENCES.

Lighthouse.—KRELL.—A long and detailed illustrated description of the new electric searchlight installation on the island of Heligoland in Germany. Three searchlights are mounted on a revolving platform symmetrically under angles of 120°, parabolic silver-plated glass reflectors being used; the platform makes four revolutions per minute.—*Elek Zeit.*, April 16.

Street Lighting.—Some details, from reports of Bradley, of the street lighting system of the City of Westminster. Electric arc lamps were introduced some years ago, but experiments were also made with incandescent gas burners. Some comparative tables of cost are given.—Lond. *Elec.*, April 17.

Train Lighting.—JACQUIN.—A long article, illustrated by diagrams, on the electric train lighting systems in use on the Prussian railways.—*L'Eclairage. Elec.*, April 18.

POWER.

Power Transmission by Gas.—BURSTALL.—An abstract of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. and of the extended discussion which followed, on power transmission by gas. He thinks a great advantage of this system would be a better load factor. The efficiency of a gas transmission scheme which had been worked out for a distance of 80 miles came out at 90 per cent., taking the mechanical efficiency of the compressor at 80 per cent. The producer station should be placed as near the coal supply as possible. The gas would be distributed at pressures suitable for the distance to which it is to be transmitted, the tabulated result being that, at the moderate velocity of 30 ft. per second, a transmission distance of 80 miles could be obtained with a pressure of 44 lbs. per sq. in., and an efficiency of 90 per cent. The gas would be led to sub-stations and the mains would distribute it to customers at a low pressure. At these stations there would be placed large gas engines for the production of two or three-phase currents at a pressure of 5,000 to 15,000 volts, according to the size of the locality covered. The current required for lighting and traction would be obtained through converters at suitable places.—Lond. *Elec. Rev.*, April 17.

Small Water Powers with High Heads.—REID.—An illustrated article on the development of such water powers for electric lighting. After calling attention to the fact that the power of small streams with high heads can, by means of storage of water, be multiplied many times whenever the maximum power is required for only a few hours out of the 24, he shows that the cost of developing and utilizing such powers will be low by reason of the small amount of water to be handled and because the water of such streams and the small amount of land required are generally valueless for any other

purpose. Such plants are generally reliable in operation, safe and clean and do not require highly skilled attendance. The cost of light thus produced will usually be much higher than by the use of oil lamps, but this will be largely offset by the attendant advantages. But due attention should be given to the question whether the flow of the stream is regular.—*Cassier's Mag.*

TRACTION.

REFERENCES.

Three-Phase Traction.—KORDA.—A very long illustrated paper read before the International Society of Electricians in Paris, on the Ganz system of high-tension, three-phase traction on the Valtellina line.—*Bull. Soc. Inst. Elec.,* March.

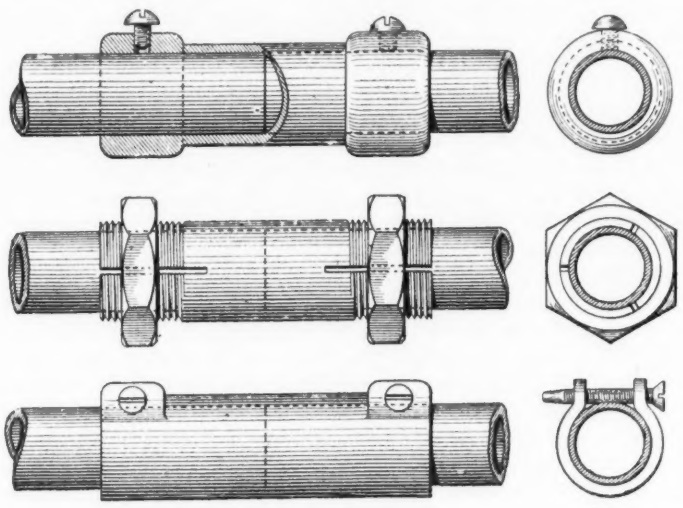
Accumulator Traction.—BIGNAMI.—A well-illustrated description of the use of storage batteries on the trains of the Bologna-San Felice and Bologna-Modena Railways, which have been noticed before in the Digest.—*L'Eclairage Elec.,* April 4.

Multiple-Unit System.—DE FRAZ.—An extremely long illustrated description of the Sprague multiple-unit system.—*Bull. Soc. Int. Elec.,* March.

Railway Signals.—HARVEY.—An illustrated article on signalling in single-line tramways, giving a brief review of hand-operated and automatic signal systems, the latter being again divided into two classes, namely those using the main trolley wire current to actuate them and requiring no additional signal wires, and those whose mechanism is operated by a shunt current, requiring two signal wires to be run the whole length of the section to be protected.—Lond. *Elec. Rev.,* April 17.

WIRES, WIRING AND CONDUITS.

Couplings for Unscrewed Conduits.—MUNRO.—An article in which he calls attention to the fact that the ordinary method of using slip couplings on a light gauge steel tube, is undoubtedly the cause of a large proportion of the accidents to lighting installations. On the other hand, unscrewed conduit systems have advantages over the screwed variety in several respects. He describes a method of making a junction between enameled tubes, which "makes a good job, but takes time," and afterwards describes three cheap and easy methods of joining enameled tubes, all three being said to be quite sound both electrically and mechanically. They are illustrated in the accompanying figures. In the first, the enamel is cut through by small, stout steel pinching screws with chisel or cone points, which also slightly distort the tube and force its cleaned outside surface hard against the cleaned interior of the coupling. In the second pattern the screw on either the coupling or the nuts is made on a slight taper, and the coupling is split along its whole length, or partially split in several places as shown. The action of screwing on the nuts compresses the cleaned surfaces into very close contact. In the third method two tengential steel pins are used which screw into small tapped lugs on the coupling. The action of "screwing them home" scrapes off the enamel and bites into the metal of the conduit, at the same time forcing the tube into compressive contact with the coupling. Any of these methods for insuring a strong and a continuous joint are said to be equally applicable to the bends and boxes of a complete system.—Lond. *Elec.,* April 17.



CONDUIT COUPLINGS.

Electric Wiring.—An account of a discussion held before the Glasgow local section of the (Brit.) Inst. Elec. Eng. Chamen pointed out how bad workmanship often caused very serious trouble. One of the most serious troubles is the improper use of metal-sheathed tubing with slip joints. What are called "electric fires" are for the most part really gas fires, though started by electricity. Wood casing is dangerous if not properly dealt with, and in fact where there is any chance of its coming into contact with continuous moisture or dampness of any kind, it should not be used at all. It was pointed out by several speakers that nothing less than screwed tubing should be accepted; in dwelling houses, "compo" gas tubing should not be used. Coates said he had used Simplex tubing with perfect satisfaction, and always took care to insure metallic continuity by bonding with copper as well as having knees, T pieces and couplings screwed, the tubing itself being of course also screwed. Tidd pointed out that there is no danger if there is a thoroughly earthed continuous metallic sheathing all the way from the lampholder down to the company's mains; the whole of the trouble with fires is entirely due to inefficient earthing. Mavor thought there is now general agreement that there ought to be a continuous earthed metallic envelope over the conductors, and that the most satisfactory method of achieving this is the use of a concentric system, with the outer conductor connected to earth. He thinks the present methods of using metallic conduits to be not only dangerous, but unnecessary. Whatever method of wiring is adopted, every precaution should be taken to see that the workmanship is first class. In his reply, Chamen remarked that all now seem to agree that one should insist upon having only solid metal tube systems, where tube systems are adopted. jointed with screwed joints throughout.—Lond. *Elec.,* April 17.

ELECTRO-PHYSICS AND MAGNETISM.

Positive Ions.—TOWNSEND.—A brief and highly mathematical article in which he refers to former investigations on the genesis of ions by the motion of negative ions through a gas, and to a recent extension of the theory, made so as to take into account any possible action of the positive ions. From the experiments which he has made, he has been led to conclude that the positive ions generated in a gas will produce others by collision with the molecules even when the electric force is less than that necessary to produce a discharge. He gives an outline of the method in which the theory has been verified experimentally, but it is of a too highly theoretical nature to be briefly abstracted.—Lond. *Elec.,* April 3.

Charge of Ions.—H. A. WILSON.—An account of an experimental investigation of the charge of ions produced in air by Röntgen rays. The method used by him depends on the fact that the ions produced in air by Röntgen rays act as nuclei for the cloudy condensation of water vapor when super saturation exceeding a definite amount is produced by a sudden expansion. The mean value of the charge found by him is 3.1 divided by the 10th power of 10 in electrostatic units, and he concludes that his experiments establish the fact that the value of the charge is between 2 and 4 divided by the 10th power of 10 in those units. (From these figures it follows that one conlomb represents 10 to the 19th power ionic charges.)—*Phil. Mag.,* April.

Alternating Arc.—GUYE AND MONASCH.—A long account of an experimental investigation of the alternating-current arc of very small intensity between metallic electrodes. In such an arc three zones may be distinguished: first the unstable zone (long arcs) which is not suitable for quantitative measurements; second, the normal zone, in which the relations between effective e.m.f. and length of the arc is linear; third, the "critical" zone. If either the distance between the electrodes, or the current, is sufficiently diminished, the phenomenon of the critical zone is observed, it is characterized by a series of disruption discharge visible in a revolving mirror and acting on a coherer. This phenomenon is general for all pure metals which were investigated, but it does not take place between carbon electrodes nor between electrodes of commercial iron, nor in the case when one electrode is carbon and the other a metal. The presence of oxygen increases the phenomenon and the extension of the critical zone.—*L'Eclairage Elec.,* February 28, April 4.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrometallurgical Production of Iron and Steel.—Brief illustrated descriptions of the Conley, Harnet, Keller, Kjellin and Stas-

sano processes. In general it is concluded that the saving of fuel when using the electric furnace does not amount to much; in the ordinary blast furnace, worked under the best conditions, one ton of iron can now be produced with 1,800 lbs. of coke and 1,400 lbs. of this total represent that required for combining with the oxygen of the ferric oxide in the ore. If the average price of coke is $5.25 per ton, the actual saving effected by using electricity as heating agent, is only $2.50 per ton of iron produced, which would have to cover the cost of the electric power, and the briquette-making. It is concluded that even when no special crushing of the ore and mixing with the fluxing, reducing and binding materials is required, as a preliminary to the operation of the electric furnace processes, competition with the ordinary blast furnace procedure is improbable. In countries where fuel is very expensive, water power abundant, and the necessary raw materials are found, these processes may have a limited field of usefulness. The blast furnace is the most perfect fuel-consuming apparatus in general use, and is estimated to possess a thermal efficiency of over 70 per cent.—Lond. *Eng.*, March 13; reprinted in *Eng. & Min. Jour.*, April 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Internal Resistance of a Battery.—OATES.—In all the ordinary methods of measuring the internal resistance of a battery there is an error due to the cell running down, which error is claimed by the author to be reduced to a minimum in the two methods which he describes, and which require no special apparatus, are easily worked and are accurate within 0.1 per cent. or less. In the first he compares the potential difference of the given battery on

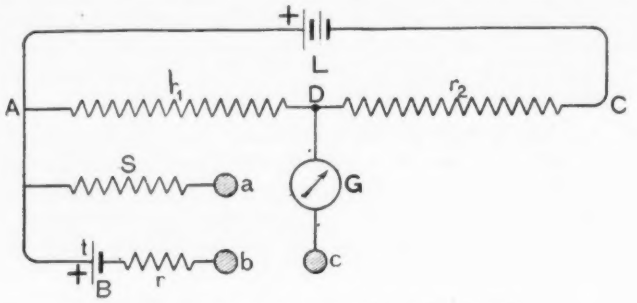


FIG. 1.—MEASURING INTERNAL RESISTANCE.

open and a closed circuit by means of a potentiometer. In Fig. 1, the sum of the resistances, $r_1 + r_2$, is kept constant at say 15,000 ohms; L is a source of about 2 Leclanche cells, S a small adjustable resistance, B the cell to be tested, r a resistance, G a galvanometer, and a, b, c, mercury cups. The resistance, $A\,D$, is first adjusted, so that on joining c to b by a short circuit, there is no deflection. Then a is joined to b and immediately afterwards to c, the resistance, $A\,D$, being adjusted so that while $A\,C$ has the old value, the drop in potential along $A\,D$ is equal to that along $A\,a$. It is necessary to get the smallest possible deflection in the direction in which B alone deflects the galvanometer; then from the two values of the resistance, $A\,D$, in both cases the internal resistance of B can easily be calculated. The shorter the interval between the connection, a, b, and the connection, a, c, the more accurate the test; he adjusts this interval by making the connections between a, b and c by three legs of a copper wire of different lengths, so that on dropping the three arms into the cups, the cell is short-circuited automatically just before it is joined to the galvanometer. The second method consists in equating the drop in potential between the terminals of the cell, short-circuited through a small resistance, to a known fraction of the potential difference between the terminals joined through a large resistance; the simplest form of connections is shown in Fig. 2, in

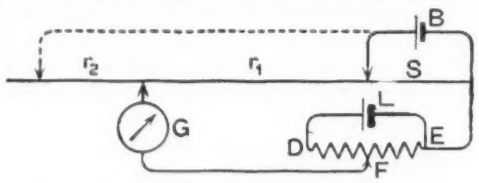


FIG. 2.—MEASURING INTERNAL RESISTANCE.

which B is the cell under test, S the small resistance, and $S + r_1 + r_2$ the large resistance. These two potential differences are equated by making an auxiliary (third) potential difference on a potentiometer equal to the first potential difference, and then making the second potential difference equal to the third, as will be seen from the diagram. Results are given of the test of a small storage battery in series with about 5 ohms; both methods agree and are certain within 0.1 per cent.—Lond. *Elec.*, April 17.

Measuring the Iron Losses.—SOSCHINSKI.—An article on the determination, by means of the wattmeter, of the "loss figure" ("Verlustziffer") in sheet iron. This figure is the loss in watts per kilogram of iron, at a maximum induction of 10,000 maxwells, a frequency of 50 per second, and at a temperature of 30° C. in the iron. The measurement is made in such a way that a piece of iron of a certain weight (at least 10 kilogrammes) and of a certain cross-section in a solenoid is subjected to the magnetizing action of an alternating current of 50 periods, the voltage at the ends of the solenoid being so chosen that in the iron cross-section there is a maximum induction of 10,000 lines, the energy consumed at the terminals of the coil being determined by a wattmeter. At the same time, the current and e.m.f. are measured and the energy per kilogram of iron is then determined. The author discusses mathematically the influence of a stray field which may exist in apparatus for this purpose. If in a piece of iron which is entirely covered with magnetizing windings, there is a stray field of the lines of induction —as is the case, for instance, in the apparatus of Richter and Epstein— then the measurement at a certain maximum induction gives a larger value for the "loss figure" than would be found if the same iron had been investigated at the same maximum induction in the form of a closed ring in which there is no stray field. In the case of a choking coil, there exists two causes of error acting in opposite directions, which may be made to balance each other, so that by properly choosing the dimensions of the core, a choking coil which is covered with windings only on the parallel cores, may be made to give the same loss as a closed homogeneous ring on which the windings are uniformly distributed. The final result of the author's investigation is that for measurements in practice sufficiently exact results are obtained with apparatus like that of Epstein or Siemens & Halske which have not the form of a homogeneous ring, and therefore have a stray field.—*Elek, Zeit.*; April 16.

REFERENCE.

Comparison of Small Resistances.—JAEGER, LINDECK AND DIESSELHORST.—A Reichsanstalt paper on two sets of comparisons of low resistances (of the order of ten-thousandths of an ohm, etc.) by means of the Thomson potentiometer method. The arrangement of the measurements is described in detail.—*Zeit. f. Instrumentenkunde*, No. 2, 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy in Fixed Direction.—BRAUN.—An article in which he first gives some historical notes on the wave lengths used by Marconi and by the author; and then he describes several experiments made for the purpose of sending the wireless telegraphy waves in a certain direction. The first of these was made by Zenneck; in the neighborhood of the vertical transmitting wire, A (i. e., at a distance of a few meters), there was a second parallel wire, B, of about the same length; if the latter was insulated from earth, messages arrived in the receiver station at a distance of about 10 km, this receiver station being in the direction of, and in line with a straight line from A to B. If, however, B was earthed, the messages no longer arrived at this station, but were transmitted in the opposite direction, namely, in the direction from B to A. A second method is the following devised by Braun; the receiver wire is not vertical like the transmitting one, but inclined about 5 m in 60 m; the receiver wire and the transmitter wire are, however, in the same plane; in this case only the vertical component of the arriving wave is utilized in the inclined receiving wire, and a correspondingly small e.m.f. is induced in that wire; but as one may consider the horizontal component and the length of the wire as nearly equal—which is sufficiently accurate for the resonances in straight wires, which are not very sharp—it follows that the electric wave propagated along the wire and the ether wave passing over it will be in phase, and there will be resonance. It follows that with an inclined receiver wire it is more important than with a vertical wire, that the length of the wire is in the right proportion to the wave length; if the inclined wire is turned out of the transmitted wire plane, the signs, if received at all, are diminished. These conclusions have been proved to be correct in practice. A third method was devised by Ligsfeld; at the receiving end he uses two parallel vertical wires, each of one-quarter wave length, which are connected together by a horizontal

wire of one-half a wave length; in the center of this latter wire the coherer is provided. If the plane of these three wires coincides with the direction of propagation of the wave, the signs received are a maximum; if the plane is perpendicular to the direction of propagation, no signs are received.—*Phys. Zeit.*, April 1.

Glasgow.—A long illustrated article on the reconstruction of the National Telephone Company's Glasgow system, in which 24 exchanges are now in full working order, and upwards of 12,000 subscribers' instruments connected. After having had the call wire system in use in Glasgow for 10 years, it was decided to reconstruct the whole of the important switchboards in this district. The method adopted is an adaptation of the "ringing through" principle to the central battery signal system, used in connection with multiple switchboards fitted with branching jacks. Diagrams of the connections are given and one of the largest exchanges is described.—Lond. *Elec.*, April 17.

REFERENCE.

Wireless Telegraphy.—GUARINI.—The first part of what appears to become a long illustrated serial on "wireless telegraphy in the United States."—Lond. *Elec. Rev.*, April 17.

MISCELLANEOUS.

British Engineers in Italy.—A full account of the recent visit of 130 members of the (Brit.) Institution of Electrical Engineers to Italy, some notes of which were already given in last week's Digest. On the Valtellina three-phase railway, the train went at full speed of 60 km per hour most of the time, the acceleration at starting being regular and smooth and its changes being hardly noticeable. The actual work of the motorman is made as simple as possible, all the operations being performed by two movements; the first is to put the controller handle either to half or full speed, and the second to open the valve of the compressed air system, which causes the liquid to rise slowly in the water rheostat, and the train then begins to move; when the resistance is all cut out, the motor is short-circuited automatically. In descending inclines no attempt is made to return energy to the line, chiefly because there are very few other trains to use it, and the sudden addition to the power supplied of something like 200 kw, would cause inconveniences; the superabundance of water at present renders the recovery of energy a matter of no moment, and the trolley is, therefore, simply lowered, while the train is coasting. Como and Volta's tomb at Camnazo were also visited. The visitors then inspected the Thomson-Houston railway system with its power house at Tornavento; the current used in the motors is 650-volt, direct-current, and is collected from a third rail. The next visit was made to a modern silk-weaving factory at Merate, which is equipped with electric motors throughout; two sets of shafting driven by separate motors of 10 hp, are used for the warping machinery; four other motors of 4 hp each are sufficient for the small machines adjoining each loom. Each loom is separately driven by a ¼hp motor, sometimes placed on a bracket and driving through spur gearing transmitting the motion by a belt or bicycle chain. One of the principal objects of employing single motors below the level of the work instead of overhead shafting is that of cleanliness; it is important with such valuable fabrics as silk to avoid the possibility of spoiling them with oil from overhead bearings; there are in all 335 looms. The transmission system of the Edison Company of Milan was then visited and attention is called to an apparatus installed at the Merate sub-station, for regulating the voltage of supply; the arrangement is that of automatically cutting out or in certain of the windings on the 3,600-volt side of the 500-kw transformer; the mechanism consists of a small three-phase motor controlled by a voltmeter relay in one or the other direction, according to the value of the pressure, and thereby actuating the sliding contacts connected with the transformer windings. Various electrical manufacturing plants in Milan were visited, among them the rubber and cable factory of Pirelli; also the Royal Technical Institute. The official visit was concluded by a banquet given to the Institution of Electrical Engineers by the Associazione Ellettrotecnic Italiani.—Lond. *Elec.*, April 17.

English Consulting Engineers.—An editorial referring to a recent remark of George Westinghouse, who contended that in many of the larger electrical schemes at present contemplated in England, especially in the electrification of railways, it will be more economical and advantageous for purchasers to place their entire contract in the hands of one firm of contractors, who act on their advice, and to take their standard designs, than to employ a consulting engineer to draw up the scheme, divide the contracts into sections and distribute them among several contractors. This statement has been under some discussion in the Lond. *Eng'ing* and this discussion is here summarized. It is not doubted that the formation of such firms as Westinghouse, Church, Kerr & Co., which are organized for carrying out complete schemes in all their details without outside assistance, may interfere to a large extent with the position which English consulting engineers have hitherto held as intermediaries between the purchaser and manufacturers. There is, however, the objection that any contracting firm, attached to a manufacturing firm, is limited to the standard designs of the latter, while in some cases standard machines may not be the best ones for the purpose. It is said that the immediate future would not seem to require so large a body of consulting engineers in England as the system of municipal trading has in the past necessitated in that country.—Lond. *Elec. Rev.*, April 17.

REFERENCE.

Manufacturing Plant.—An illustrated description of the Queen's Engineering Works, at Bedford, at which special machinery is made, such as steam dynamos, centrifugal pumping engines for the British Admiralty, small electric gear for the mercantile marine, and machinery for large central stations.—Lond. *Elec. Rev.*, April 17.

New Books.

CONDUCTORS FOR ELECTRICAL DISTRIBUTION. Their Materials and Manufacture. By F. A. C. Perrine, A. M., D. Sc. New York: D. Van Nostrand Company. 287 pages, illustrated, with 5 charts in cover pocket. Price, $3.50.

Dr. Perrine's large experience as manufacturer, teacher and engineer is a sufficient guarantee of the practical value of the present volume. It is a most interesting and complete account of the manufacture of electrical conductors, their calculation and erection, which meets a real need in the engineer's library. There are plenty of books which treat of line computation, some of them much more fully than the one before us, but Dr. Perrine has gathered a great mass of practical information about the materials of line construction which cannot be duplicated elsewhere, and has utilized it most skillfully. The first half of his book is devoted wholly to the conducting materials and their practical manufacture into wires and cables insulated and uninsulated. Here the author draws directly upon a very wide personal experience, and the first two chapters in particular are full of facts and figures important to the engineer. The description of the processes of wire and cable manufacture are singularly clear and complete, giving an insight into many details which affect the quality of the product and generally escape the notice of the engineer.

Chapter VII takes up the calculation of circuits in general, and gives besides the ordinary formulæ many valuable data concerning the heating of covered conductors, and in connection with the theory provides some simple wiring charts, which may be found—until they are lost—in a pocket on the inside of the back cover. Chapter VIII is devoted to the discussion and amplification of Kelvin's law of maximum economy of conductors. It is well worked out and has a rich academic flavor, but just why nineteen valuable pages in a work intended to be practical should be devoted to a theorem inconvenient to apply and useless when applied, we do not quite comprehend. The fundamental trouble with it is that the quantities concerned most directly are independent, variable, following no known law, and having different values at different epochs. Until one can determine the price of copper and the effect of competition with respect to time, he had better leave Kelvin's law to the classroom.

In full compensation for this infliction, Dr. Perrine provides in Chapter X a very beautiful and important graphical treatment of the calculation of alternating-current lines. It is altogether the neatest thing in the book, and one thing especially to be commended from the instructional point of view is the separation of the constants of the line from those of the apparatus during a part of the discussion. The apparatus is in many instances a much more important factor than the line. The succeeding chapters on pole lines and insulators are also most valuable, taking up as they do many matters not usually considered and still of great practical importance. The final chapter on underground conductors is by compari-

son less rich in practical details, but still most instructive as a review of the state of the art. The time is hardly ripe for a complete practical discussion of underground lines, but from the present outlook experience will accumulate very rapidly from now on.

On the whole Dr. Perrine has produced a most meritorious and valuable work, covering ground heretofore almost untouched, and full of practical data, the importance of which can hardly be overestimated. It should command immediate personal attention from the engineering fraternity.

BOOKS RECEIVED.

EXPERIMENTS WITH VACUUM TUBES. By Sir David Salomons, Bart, M. A. 49 pages, 54 illustrations. Price, 2 shillings.

HOW TO BECOME A COMPETENT MOTORMAN. By Virgil B. Livermore and James Williams. New York: D. Van Nostrand Company. 232 pages, illustrated. Price, $1.00.

TELEPHONE LINES. Methods of Construction, Overhead and Underground. London: Whittaker & Co. By Walter C. Owens. 390 pages, 265 illustrations. Price, 5 shillings.

ELECTRICAL PROBLEMS. By Prof. William L. Hooper. Boston: Ginn & Company. 170 pages, illustrated. Price, $1.25.

ANNUAIRE POUR L'AN., 1903. Publié par le Bureau des Longitudes. Avec notices scientifiques. Paris: Gauther-Villars. 668 pages. Price, 1.50 francs.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Annual meeting, May 19. Papers: "The Experimental Basis for the Theory of the Regulation of Alternators," by B. A. Behrend; "The Heyland Motor," by C. A. Adams, Jr.

AMERICAN ORDER OF STEAM ENGINEERS. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Wm. J. Davis, Ithaca, N. Y.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION. F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION Secretary. E. M. Coleman, Louisville, Ky.

IOWA TELEPHONE ASSOCIATION, Secretary, C. C. Deering, Des Moines, Iowa.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich, July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary G. H. Guy, 104 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION. Secretary, E. W. Pichardt, Huntingburg, Ind.

Objections to the Proposed Cable Vocabulary.

As already noted in these pages, a strong opposition has developed in the United states to the proposed limitations of cable vocabularies. A meeting of the signers of the protests to be presented to the International Telegraph Conference at London on May 26th, was held at the New York Chamber of Commerce last. week, Mr Henry Hentz presiding, and Mr. Howard Ayres, of the China & Japan Trading Company, acting as secretary. The following preamble and resolutions were unanimously adopted :

Whereas, it is anticipated that, at the conference of the International Telegraph Convention of Berne, to be held in London, May 26th, 1903, an attempt will be made to adopt for compulsory use the official vocabulary prepared by the bureau at Berne; and

Whereas, it is apparent that the official vocabulary is not sufficiently comprehensive and is inadequate to commercial needs; and

Whereas, the enforced use of the official vocabulary would make necessary revision to an insufficient medium of codes now in use at great labor and expense an unjustifiable burden upon commerce, as expressed by the Chamber of Commerce of the State of New York in their protest, passed at the meeting held April 2d, 1903; therefore be it

Resolved, that the signers of the petition for the withdrawal of the official vocabulary now in meeting at the rooms of the Chamber of Commerce, New York, protest against the compulsory use of that or any fixed list of ciphers; and be it further

Resolved, that this meeting express to the International Telegraph Convention its conviction that the existing conditions demand not restriction, but a broadening of cable code facilities and that this meeting is strongly of the opinion that properly constructed systems of roots and terminals are a necessity in business telegraphy; and be it further

Resolved, that the chairman of this meeting appoint delegates to formally present these resolutions and our protests.

The following interests were represented: Standard Oil Co., China & Japan Trading Co., American Trading Co., Brown Bros. & Co., the Wall Street Journal, W. R. Grace & Co., Carnegie Steel Co., Henry Hentz & Co., Bowring & Co., Boston News Bureau, Carlton & Moffatt, Westinghouse Companies, Guitterman, Rosenfelt & Co., George Hamilton, Fearon, Daniel & Co., Walker & Hughes, Philadelphia News Bureau, A. O. Probst, American Institute of Marine Underwriters, Dow, Jones & Co., H. W. Doremus & Co.

Electricity for Gas Works Operation.

An interesting gas power plant is now being installed at the works of the Milwaukee Gas Light Company, Milwaukee, Wis. The company is erecting a new gas works which will be one of the largest in the country, and will embody the most advanced practice in modern gas engineering. Although no electricity will be generated for outside lighting, a gas engine-driven electrical plant will be employed for furnishing motive power to the various auxiliaries throughout the works, all of which will be operated by electric motors. A large machine shop will also be operated by electric motors. Coal will be unloaded from boats elevated to the storage bins by electrical hoists and conveyors, the retorts will be charged and drawn by electrical appliances, and the final disposition of the coke will be accomplished by means of electric power apparatus. The entire electrical distribution system will operate at 250 volts direct current from a central power generating plant, employing gas engines connected directly to the gas mains.

The present equipment comprises one 250-hp Westinghouse horizontal double-acting gas engine, driving a 150-kw generator, and three 125-hp vertical engines, belted to 75-kw generators. Provision has been made for extension of the equipment with a second power unit of the former type. The 250-hp engine is of the new horizontal type recently introduced by the Westinghouse Company for general power work. Its principal features are a pair of horizontal cylinders arranged in tandem, and operating upon the double-

acting principle, single-crank and water-cooled pistons, cylinders and combustion chambers. The engine is particularly adapted to generator driving by reason of its excellent speed regulation due to the method of governing employed, which at each stroke proportions the explosive charge to the load, but maintains at all times a mixture of constant quality.

S. K. C. Circuit Breaker.

The circuit-breaker illustrated herewith embodies several features which distinguish it from similar devices. Prominent among these is the independent opening action. The breaker cannot be closed

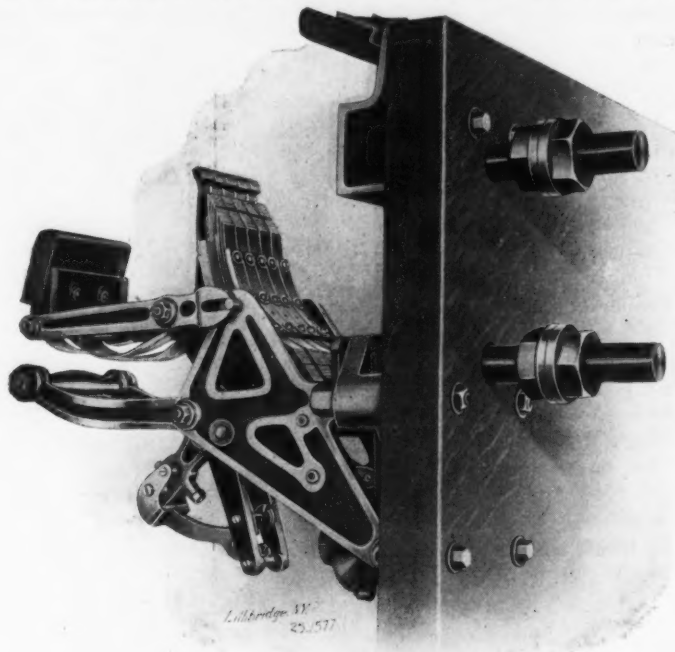


FIG. 1.—CIRCUIT-BREAKER OPEN.

on an overload, for should an attempt be made to do so, the closing toggle will be automatically disconnected from the operating handle and the jaws will open, regardless of the pull which is being applied to the handle, the instant that sufficient current passes through the carbon contacts to operate the tripping device. Thus the danger resulting from a circuit-breaker being forced in upon an overload is eliminated. To trip by hand, the closing action is simply reversed; that is, the operating handle is pushed up.

By an ingenious arrangement of the iron core and the magnet coil, two turns are made around the core in a limited space. The iron core consists of two parts, one fixed and the other movable, which are so arranged as to have but one air gap in the circuit. The movable portion of the core operates the tripping device, as can be seen in Fig. 4.

The main contact blocks are bridged by a sectional laminated copper arm, each section of which may be adjusted separately to secure the best contact, which adjustment is very simply accomplished. The main contact blocks are fastened to the marble base independently of the studs, which may be of any length to suit the switchboard construction.

An objection to circuit-breakers made with fixed carbon blocks with parallel faces, is that these in receiving the full impact when the breaker is closed, often fracture from the blow. In the present circuit-breaker these carbon blocks have a certain amount of spring-actuated movement and come together with a sliding action, as can be seen from the illustration, which renders their breaking impossible from the cause noted. The surfaces are unusually large, and the rubbing action taking place between them when the breaker is opened or closed insures clean contacts. As will be seen from the illustrations of the breaker opened, Figs. 1 and 3, a long break between the carbons is secured with a comparatively short movement of the main contact arm, and arcing occurs at a safe distance from all metal parts. In addition to the shunt circuit through the carbon contacts, there is also an auxiliary shunt composed of smaller copper arms, which remain in contact momentarily after the main contacts are opened, thus further protecting the latter. The contact arms, both the main and the auxiliary, are clearly shown in Fig. 1.

The setting device consists of a rack having a projecting bracket upon which rests the movable section of the magnetic core, and a pinion, engaging therewith, at the end of a short shaft, which carries on its outer end a helical spring, a notched dial and an insulated knob, the arrangement of these parts being shown in Fig. 4. By rotating this dial, the air-gap in the tripping magnet may be varied and a fine adjustment secured. The operation of setting consists simply in pushing the knob, so that the dial is free from the index pin holding it secure, and rotating it until the figure indicating the desired tripping point is opposite the index pin. On releasing the knob, the dial springs out and locks itself in the pin. The large diameter of the setting dial gives, on its periphery, a scale approximately nine inches long.

These circuit-breakers operate on either direct or alternating-current circuits and are made in capacities from 200 to 3,000 amp. They were designed by the engineers of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and are being put on the market by that company.

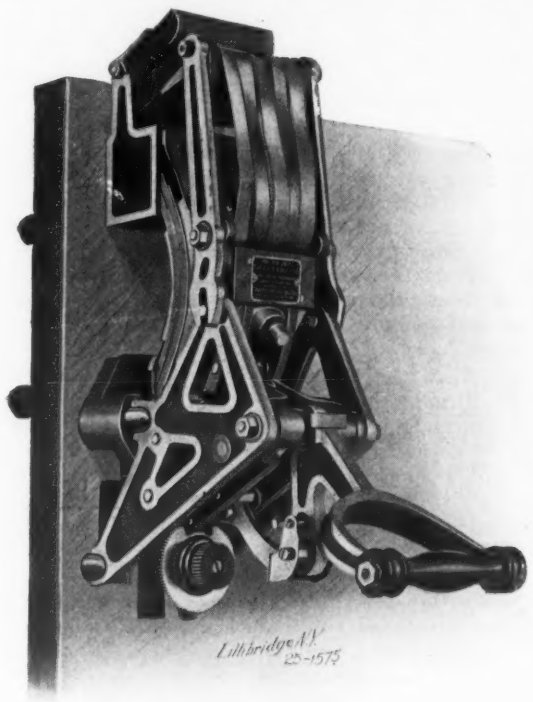


FIG. 2.—CIRCUIT-BREAKER CLOSED.

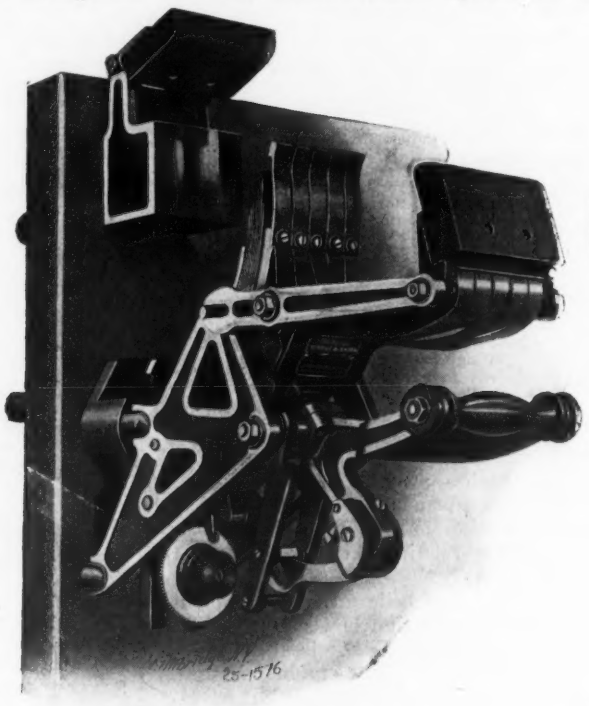


FIG. 3.—CIRCUIT-BREAKER OPEN.

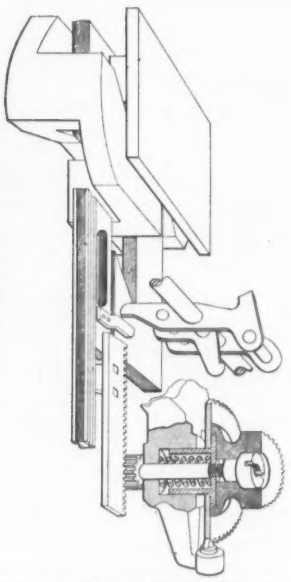


FIG. 4.—DIAGRAMMATIC VIEW OF CIRCUIT-BREAKER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered freely, but there was not much demand, the closing price being 4¼ per cent. for 60 to 90 days and 4½ per cent. for four, five and six months. The stock market was dull and narrow and of a professional character. There was, however, some increase in the investment buying of both bonds and stocks, due, in part, to the easy condition of the money market. The market in general was a variable one and the fluctuations were confined to narrow limits. The traction stocks seemed to receive about as much attention as any other portion of the list, this fact being due not only to the franchise tax decision, but to the development in connection with the hearing of a libel suit growing out of the charges recently brought against the management of the Metropolitan Street Railway Company. The charges against the company appear to have been utterly discredited, and the libel suit has been dismissed for good. Manhattan was well supported in the face of the adverse decision of the Court of Appeals on taxing franchises. Although the whole group was heavy at first, they all, including Brooklyn Rapid Transit, developed a tendency to recover after the news had been announced that the Court of Appeals had decided against the companies. United States Steel stocks were relatively firm and some strength was exhibited by American Smelting & Refining; on the other hand, Amalgamated Copper was almost entirely neglected. Metropolitan Street Railway touched 129 at one time during the week, but recovered and closed at 133½, being a net gain of 3¾ points. Brooklyn Rapid Transit closed at 66, a net gain of 1 point, the lowest quotation being 64¼. General Electric was very quiet, only 1,348 shares having been dealt in, the closing price being 193½. Westinghouse common closed at 210, and first preferred at 195, the first being a net gain of 3¾ and the latter a net loss of 15 points. Western Union lost ½ point, closing at 85. Following are the closing quotations of May 5:

NEW YORK.

	Apr. 28.	May 5		Apr. 28.	May 5
American Tel. & Cable	75	80	General Electric	192⅛	192
American Tel. & Tel.	160	158	Hudson River Tel.	..	..
American Dist. Tel.	..	31	Metropolitan St. Ry.	130⅛	134¼
Brooklyn Rapid Transit	65¾	66¼	N. E. Elec. Veh. Trns.	..	¼
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	22	N. Y. E. V. T. Co.	..	..
Electric Boat pfd.	35	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	1¼	1¼	Western Union Tel.	85	85¼
Electric Vehicle.	12	11⅝	Westinghouse com.	195	210
Electric Vehicle pfd.	15	15	Westinghouse pfd.	195	210

BOSTON.

	Apr. 28.	May 5		Apr. 28	May 5
American Tel. & Tel	160⅞	158¾	Western Tel. & Tel. pfd.	96	96
Cumberland Telephone.	..	..	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum.	..	..	New England Telephone	136	138
General Electric.	..	..	Westinghouse	95	..
Western Tel. & Tel.	10	10	Westinghouse pfd.	95	..

PHILADELPHIA.

	Apr. 28.	May 5		Apr. 28.	May 5
American Railways	..	49½	Phila. Traction	97¼	97⅛
Elec. Storage Battery	74	74*	Phila. Electric	7⅛	7⅛
Elec. Storage Battery pfd.	..	74*	Pa. Electric Vehicle	..	..
Elec. Co. of America.	8⅞	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Apr. 28.	May 5		Apr. 28.	May 5
Central Union Tel.	..	..	National Carbon pfd.	96	97
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry	205	206½	Union Traction	6¼	5½
Chicago Tel. Co.	..	..	Union Traction pfd.	33	32
National Carbon	24¼	24			

*Asked.

WESTINGHOUSE ELECTRIC.—A special telegram from Pittsburg of May 2 says: Westinghouse Electric second preferred closed at 105½ bid, a net advance from the low price of the week of more than $10 a share. The basis for the advance was a rumor that the company was about to issue a portion of the $7,000,000 treasury stock, but an authoritative statement relating thereto was not obtainable until after the market closed. A prominent officer of the company made the following statement: "I believe the Westinghouse Electric and Manufacturing Company will shortly issue some additional stock from the $7,000,000 still unissued. At least the advisability of this plan is now under discussion. The authorized capital of the company is $25,000,000 and the issued capital is $18,000,000. The sales for the year ending March 31, 1903, were $24,000,000, an increase of 30 per cent. over the sales for the year ended March 31, 1902. The earnings from the sales were over $4,500,000, and after writing off large amounts and paying dividends and interest the present surplus is upward of $8,000,000. In case the company were to issue to the stockholders at a favorable price $4,500,000 out of the $7,000,000 stock now in the treasury, the entire capital issued would yet be only one-half that of the General Electric Company, with its capitalization of $45,000,000."

ELECTRIC COMPANY OF AMERICA.—At the annual meeting of the stockholders of the Electric Company of America, held a few days ago, President Snowden presented the annual report showing net earnings of $349,546 in 1902, as compared with $281,382 in 1901, a gain of 24 per cent. The surplus account at the end of 1902 showed a credit of $453,776. The company has no floating or bonded indebtedness and the interest charges on some of the underlying corporations have been reduced by payments and refunding operations. The plants operated were stated to be in the highest condition of efficiency. The directors of the company were unanimously re-elected. The earnings for the first three months of 1903 were $91,280, an increase of $16,607, or 22 per cent. over the corresponding period of 1902. The income account for the year ended December 31, 1902, compares with the three previous years as follows:

	1902	1901.	1900.	1899.
Net earnings	$366,587	$281,232	$374,538	$407,975
Other income	26,956	198,954	36,156	633,369
Total income	$393,543	$480,186	$410,694	$1,041,344
Charges	41,064	.....	.....	.....
Balance	$352,479	$480,186	$410,694	$1,041,344
Dividends	203,980	306,038	406,281	202,419
Surplus	$148,499	$174,148	$4,413	$838,925
Previous surplus	916,194			
Total surplus	$1,064,693			
Extra div. paid June, '02	610,917			
P. & L. surplus	$453,776			

AMERICAN BELL TELEPHONE.—The American Bell Telephone Company has filed a certificate of condition as of March 31, 1903, which we compare with statement of March 25, 1902:

Assets:	1903.	1902.
Cash and debts receivable	$5,000,000	.....
Stock of Amer. Tel. & Tel. Company	27,124,800	32,131,800
Total	$32,124,800	$32,131,800
Liabilities:		
Capital stock unexchanged	$7,000	$10,700
Debt	10,000,000	10,000,000
For exchange of shares outstanding	7,200	10,700
Balance outstanding assets	22,110,400	22,110,400
Total	$32,124,800	$32,131,800

On March 31, 1903, there were 72 shares of Bell stock not exchanged in the hands of nine stockholders. Charles W. Amory, Alexander Cochrane and Henry Showe as trustees for the American Telegraph & Telephone Company, own 258,686 shares, as against 258,651 last year.

MISSOURI EDISON COMPANY.—It is reported from St. Louis that plans for the absorption of the Missouri-Edison Electric Company by the North American Company have been about completed. The New York corporation, it is said, is in actual control of the Missouri-Edison, and has been for some time. The terms upon which the deal was made have not been made public as yet. It was stated on good authority, however, that the stock is taken on a basis of $50 for the preferred and $25 for the common.

BIRMINGHAM (ALA.) LIGHT & POWER.—A meeting of the stockholders of the Birmingham Railway, Light and Power Company., held at Birmingham, Ala., resulted in an increase of the capital stock to $6,000,000. This is an increase of $1,000,000, all preferred stock. A dividend of 1½ per cent on the common stock was suggested, and will be issued July 1. The new capital stock will participate after July 1. The cash derived from the increase will be used in extensions and improvements.

ELECTRICAL PRODUCTION.—It is noted by the financial papers that while the General Electric Company has transacted a business of $36,000,000 the past year upon a capital of $45,000,000 stock, the Westinghouse Company has done a business of $24,000,000 upon a capital of $18,000,000, that is, sales have exceeded the issued capital by one-third.

MONTREAL POWER BONDS.—The entire issue of Montreal Heat, Light & Power Company's 5 per cent. thirty-year bonds, amounting to $3,400,000, offered by N. W. Harris & Co., of New York, and the Bank of Montreal, has been disposed of. These bonds were issued for the purpose of the plant of the Lachine Hydraulic Power Company, as already noted in these pages.

GENERAL ELECTRIC STOCK DIVIDEND.—According to advices from Boston, it is stated by men high in the management that the General Electric Company has in mind the payment of a 10 per cent. stock dividend this year if business conditions continue as at present, and there are no signs of a let-up at the present time. The company is extremely liberal in its charges to depreciation, yet earnings show 25 per cent. for its stock and the management believes that stockholders should benefit from these large earnings to a greater extent than 8 per cent. per annum. As the directors are not in favor of increasing the cash dividend the only way that the stockholders can derive benefits is in the shape of stock dividends. While there has been no definite decision in regard to the matter, it is understood that the directors have informally talked it over and this method meets with the general approval of the members of the board.

FAILURE OF HELIOS-UPTON COMPANY.—Norman W. Bingham, of Somerville, Mass., and Edward Davis, of Philadelphia, have been appointed by Judge Colt in the United States Circuit Court, at Boston, receivers of the Helios-Upton Company, a New Jersey corporation, with places of business at Peabody, Philadelphia and Chicago, and engaged in the manufacture of electrical appliances. The receivers were appointed in a suit brought by King Upton, of Salem, a creditor with a claim exceeding $76,000 and the largest stockholder in the corporation. The debts of the company, it is alleged, exceed $235,000, and it is unable to pay them promptly. The receivers, who are appointed to conserve the interests of the creditors and the stockholders, are authorized and directed to carry on the business. Each gave a bond for $25,000.

Commercial Intelligence.

THE WEEK IN TRADE.—There was some unsettled feeling in the trade and industrial situation, due to weather conditions and labor disturbances. General business and crop conditions, however, remained favorable. Cold weather and snow in the West checked farm work; interfered with retail distribution; retarded re-orders and did some damage to winter wheat. In the East, however, opposite conditions were noted. There the weather was springlike, which gave a needed stimulus to retail distribution. Strikes are numerous, though few of them are of long standing, the tendency being for employers to concede most of the demands or submit them to arbitration. The gross railway earnings for the first three weeks of April promise to exceed those of a year ago by 14 per cent., and the net returns so far received for March are extremely favorable. Wholesale trade is seasonably quiet. In the textile trade the strike of Lowell cotton goods employees still continues, while the abnormal condition of cotton prices checks large operations. Pig iron was generally dull, except at Pittsburg, where a quite heavy movement was reported. Steel billets are as scarce as ever, and structural material, plates, sheet bars and rails are in active request at firm prices. Some other metals are weaker, lead being marked down 30 cents per hundred pounds. Copper is also lower, both at home and abroad, and the market was very weak. The quotations of the Metal Exchange are 14¾ to 15c. for Lake and electrolytic, and 14½ to 14¾c. for casting stock. The business failures for the week ending April 30, as reported by *Bradstreet's*, numbered 173, against 132 the week previous, and 174 the corresponding week last year.

ALLIS-CHALMERS GAS ENGINES.—It was stated last week by Mr. E. D. Adams, New York member of the Executive Committee of the Allis-Chalmers Company, that the Allis-Chalmers Company may soon have to double the size of their great works, although the new works, which have just been completed, cost between $2,000,000 and $2,500,000. The taking of a contract for the exclusive construction of German gas engines by the Allis-Chalmers Company is responsible for the great project. The company has secured the sole right for building and erecting the engines of a firm in Nüremberg and Augsburg for the United States, Canada, British Columbia and Mexico. The German manufacturers have produced an engine, says Edwin Reynolds, consulting engineer of the Allis-Chalmers Company, which is apparently destined to revolutionize many lines of manufacture. The principal feature is the use of the gas generated by the fuel in blast furnaces for supplying heat and power, instead of operating engines as now built with the usual application of fuel and steam. It is anticipated that there will be a great demand for the new machines, in other fields as well, such as the electrical. A member of the company speaks with the highest praise and satisfaction concerning the German invention. He says that a 2,000-hp unit will be built at the Milwaukee shops for exhibition at the St. Louis Fair.

HOOSICK RIVER WATER POWER.—The Schaghticoke (N. Y.) Electric Company has just been incorporated by George E. Greene, S. E. Gibson, E. H. Libby, Frank H. White and H. J. Greene. The capital stock is placed at $30,000 in certificates of incorporation. It is understood that the capital stock will be largely increased. The main object of the company is to develop a water power about one mile below Schaghticoke village in Rensselaer County on the Hoosick River. The river at that point runs through a deep narrow gorge and winds around a peninsula for over a mile, so that at the narrowest point of land or at the neck of the peninsula and on the south side the river flows within 300 ft. of its course on the north side, but the fall between the two points is 35 ft. The company proposes to tunnel this neck and to build a dam 35 ft. high just below the tunnel, which will give a 70-ft. head. It is claimed that 5,000 hp can be developed at a very moderate expense. A large amount of land and water rights have already been acquired.

YORK ELECTRIC & MACHINE COMPANY, of York, Pa., proposes to furnish a complete equipment for the manufacture of incandescent lamps "according to the latest developments, sacrificing nothing in point of quality while attaining a minimum cost of production." This includes machinery for accomplishing or greatly assisting every operation in the glass room, as well as the necessary machinery and apparatus for other parts of the factory. Mr. J. E. Graybill, of York, is the president of the company; Mr. J. P. Trimmer treasurer, and Mr. Paul McJunkin secretary. Mr. Louis A. Drexler, of Braddock, is also one of the directors.

THE WHITE MOUNTAIN PAPER COMPANY has recently purchased from the Westinghouse Electric & Manufacturing Company three 1,000-kw and one 300-kw, three-phase, engine type alternators, which are complete with exciters, and are to be direct-connected to Hamilton-Corliss engines installed in its paper mill at Portsmouth, N. H. The various machines in this mill will be operated by Westinghouse induction motors, aggregating 5,500 hp. When this apparatus is in operation it will comprise the largest individual electrical installation in a paper mill in the world.

LIGHTING A CLEVELAND STORE.—Mr. J. Harkness Brown has recently closed a contract with the Nernst Lamp Company, of Pittsburg, Pa., for over 1,500 Nernst lamps, which are to be used for lighting his large department store on Euclid Avenue, Cleveland, Ohio. The lamp is especially fitted for illuminating dry goods stores, not only for the reason that 90 per cent. of the light is thrown to the counters and floors where it is most needed, but also on account of the daylight quality of the light, rendering a correct determination of color possible.

TUERK FANS FOR VARIOUS FOREIGN COUNTRIES.—E. B. Latham & Co., 39 Vesey Street, New York, general and export agents for the Hunter Fan & Motor Company, of Fulton, N. Y., have lately secured several substantial orders for Tuerk alternating-current ceiling fans for shipment to India, Brazil, Japan, England, Germany and Chili. Orders sent from the first two countries have been considerable. As regards domestic trade the South is the largest buyer at present. An order has also been received last week for 200 direct-current ceiling fans for shipment to Providence R. I.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Savannah Electric Company, Savannah Ga., for the installation of a battery of "Chloride" accumulators having a capacity of 480 amp. for regulating the rapid fluctuations on their railway circuit. This battery is also to be used in connection with the lighting system, and is operated in connection with a specially wound motor-driven booster. The lead-lined tanks for this installation are made sufficiently large to double the capacity of the battery when an increase is necessitated.

THE PACIFIC ELECTRIC RAILWAY COMPANY, of Los Angeles, has closed a contract with the Westinghouse Electric & Manufacturing Company for four 100-hp and three 30-hp induction motors, which will be used to operate the auxiliaries, including the air-circulating pumps in the steam power electric generating plant in Los Angeles. The contracts for the main engines and condensing apparatus were placed through Charles C. Moore & Co., of San Francisco.

MEXICAN HYDRAULIC PLANT.—An extensive hydraulic plant is to be constructed on the Tequisquiapam River in the vicinity of Queretaro. The Compania Explotadora del Tequisquiapam will undertake the work. The plant will generate the necessary current for the purpose of operating the interurban railway, which the before-mentioned company is constructing between Queretaro and Tequisquiapam.

AUSTRALIAN AGENCY.—The Niles-Bement-Pond Company, 136 Liberty Street, has appointed the electrical engineering and contracting firm of Noyes Brothers, of Sydney and Melbourne, as its exclusive representative in Australia. The Noyes people also represent the Australian interests of Westinghouse, Church, Kerr & Co., J. G. Brill Company, and Billings & Spencer.

ELECTRICAL EQUIPMENT FOR PERUVIAN MINES.—The Allis-Chalmers Company, Broad Exchange Building, New York, will shortly let the contract for the electrical equipment of the Cerro de Pasco copper and silver mines, Peru, now being developed on an extensive scale by American capitalists headed by J. B. Haggin, Mills Building, New York.

DE FOREST WIRELESS TELEGRAPHY.—Dr. Lee De Forest has just returned from a trip through the West and to the Pacific coast. At Cape Flattery the extreme northwest point of the United States, a site has been secured for a transpacific wireless telegraph station. Here three towers 225 ft. high will be erected in a triangular arrangement supporting three vertical screens of wire. The power of this station will be 90 hp and it will operate with similar stations at Dutch Harbor, which will be a relay of a station at Nome, Alaska. The service will be carried westward to Kamschatka and Japan. Work is now actually under way at Cape Flattery and it is estimated that the station will be ready for operation in September. Contracts for the work have been placed in the hands of the Kilbourne & Clark Company. An exact duplicate of this Cape Flattery station is to be erected near the Administration Buiding upon the Exposition grounds at St. Louis. Work upon this station is already under way. Mr. G. H. Barbour, the chief engineer of the company, is now in St. Louis supervising the work. One of the three towers at St. Louis will be larger than the others and will be surmounted with a visitors' gallery. High-speed elevators will convey visitors to the top of this tower. Certain novel electrical effects will be tried in connection with it. At the top of each there will be a crown of incandescent lights and a series of large Geisler tubes will be attached to the top of the antenna screens. As the voltage will be from fifty to seventy-five thousand, very weird and beautiful effects will be obtained whenever the transmitting key is operated. Arrangements have been made with the *St. Louis Dispatch* and *Post-Dispatch* for the transmission by wireless of the fair news each day into the city. This station is also expected to operate with the De Forest station at Chicago. As a result of the successful demonstration between Armour & Co.'s stock yards and the executive offices over the heart of Chicago, Armour & Co. have given the American De Forest Wireless Telegraph Company contracts to connect their Omaha and Kansas City plants. Contracts have been let for the erection of the towers at each of these stations and 20 hp is the equipment to be installed at each place. At the Kansas City plant the Armours have two dead brick stacks 175 ft. high. These are to be capped with four tripods 75 ft. in height, making a total of 250 ft. The operating station at Kansas City is to be located on the roof of the packing house midway between these stacks. Alternating current will be obtained direct from the packing house dynamo. Ground has been broken at North Evanston, Chicago, for the erection of a single tower 200 ft. in height for the Lake Michigan station. This station is to cover the lake as far as Mackinaw and long-distance overland experiments will be made from this point, with a view of connecting the Armour stock yards in South Chicago with their plants at the other two stations. If these tests are successful, the De Forest Company will connect the Armour plants at Fort Worth, Texas, Fort Smith, Ark., Kansas City, East St. Louis, Chicago and Omaha.

STEAM TURBINE INSTALLATION.—The Rome Brass and Copper Company, Rome, N. Y., have just placed an order with Westinghouse, Church, Kerr & Co. for a steam turbine power equipment for a new rolling mill at Rome, N. Y. The present properties of the company are located upon the banks of the Mohawk River, at Rome, N. Y., and comprise a number of rolling mills and other buildings, scattered over a considerable area. The manufacturing facilities afforded by these mills being inadequate, the company has under way a number of new mills located at a short distance from the old plant, and arranged with special reference to the ultimate centralization of motive power. One of the new shops will be operated entirely by electricity from an adjoining power-house, where the boilers and turbine machinery will be located. The entire mill will be operated from one turbine, no relay being provided. The power unit consists of a Westinghouse steam turbine direct-connected to a 400-kw Westinghouse 3-phase turbo generator. The present arrangements for boiler and condenser machinery are still incomplete, but it is probable that the turbine will operate under 150 lbs. steam pressure, 26" or 28" vacuum, and possibly a moderate amount of superheat. The generator will furnish current at 440 volts and 60 cycles, which will be used at this voltage upon the motors driving the rolls in the mill. Each roll will be independently driven by a Westinghouse induction motor of suitable capacity.

GERMAN STEEL FOR UNITED STATES NAVY.—The General Supply & Construction Company, Maritime Building, New York, has secured the contract for the furnishing of steel to be used in the construction of the machine shops, etc., of the new navy yard at Charleston, S. C. The material will be of German manufacture, the government officials having decided to utilize foreign steel owing to better prices and more favorable terms of delivery than from American mills. This will be the first instance of foreign steel being used in the erection of United States Government buildings, though, as previously noted in these columns, considerable European structural material has been ordered recently for various building operations throughout the East, South and Middle West. The present contract calls for about 1,000 tons. Delivery is to be made in four weeks. The General Supply Company is now figuring, on behalf of foreign mills, on the contract for the structural material for the large plant about to be constructed in Beverly, Mass., by the United States Shoe Machinery Company. More than 10,000 tons of steel will be employed. The Beverly plant will be operated largely by electricity.

EUROPEAN ELECTRICAL INTERESTS.—A cable dispatch in the *New York Herald* of April 29 from Berlin says: Important negotiations will be concluded in this city within a few days for the organization of an international electrical trust, embracing the American General Electric Company, the British Thomson-Houston Company and a newly formed German electrical trust, the Allgemeine Electricitäts Gesellschaft, and the Union Company, of this city. Messrs. Potter and Clark, of the General Electric and Thomson-Houston Companies, will arrive here shortly to confer with the German leaders. The new electrical trust purposes to obtain control of the British and Continental markets. It already controls the Union Company, of this city, which was recently fused with the German General Electric Company, under the leadership of Herr Rathenau. To contest the trust Siemens & Halske and the Schukert Companies recently formed a combination, and it is likely that the Westinghouse Company will form an alliance with these companies, as Mr. George Westinghouse is due here shortly.

KOBE, JAPAN, EXHIBITION.—At this excellent exhibition opening on April 19, Messrs. L. J. Healing & Co., of Yokohama and Kobe, have on view a display of British electrical apparatus. Messrs. Hunter & Co., of Kobe and Osaka, have an exhibit of electrical apparatus, machinery, etc. German searchlights from Nüremberg are also on view. Messrs. H. Isono & Co., of Tokyo, Yokohama and Osaka, show a model of a Parsons turbo-generator from Newcastle-on-Tyne. The Mitsui Bussan Kaisha show an English engine and dynamo. The Mitsui Shibaura Engineering Works, of Tokyo, show motors and generators of home construction. American electrical apparatus is not noted as cutting any figure at all.

THE AMERICAN RIVER ELECTRIC COMPANY, whose incorporation was noted in this department last week, has closed contracts with the Westinghouse Electric & Manufacturing Company for two 2,000-hp revolving field three-phase engine generators. Deliveries are promised in five months. These generators will be direct-connected to two impulse wheels operated under a head of 590 ft. of water, which will be obtained from the American River near Placerville. Electric power will be transmitted 75 miles to Stockton at 40,000 volts. A part of the pole line is under contract.

PITTSBURG CARBORUNDUM COMPANY.—As already intimated in these pages, the Carborundum Company of Pittsburg, has practically decided to erect a plant in the German Empire, in order to compete with the German manufacturers, as the proposed high tariff and the cost of shipment promises to cut down profits to a large extent. Large shipments are made to Germany from the plant at Niagara Falls, but German manufacturers have been adopting American methods and competition is becoming more keen.

AMERICAN CONDUIT FOR RUSSIAN TELEPHONE SYSTEM.—Some details are to hand regarding the important contract recently secured for American conduit to be installed in connection with the municipal telephone system in St. Petersburg, Russia. The value of the contract is about $3,000,000. The American Vitrified Conduit Company, New York, will ship the conduit. There will be about 6,000,000 ft. of four-way conduit, which will represent a weight of some 25,000 tons.

SPRAGUE ELEVATORS FOR AUSTRALIA.—The Sprague Elevator Company, 52 Broadway, New York, has recently secured some substantial contracts for electric elevators for passengers and freight service in Australia. Edge & Edge, of Sydney, have taken a contract for elevators in the new warehouse of W. S. Friend & Co., in that New South Wales city. Sprague elevators have also been ordered for installation in the new premsies of the Adelaide Steamship Company.

THE H. O. S. ENGINEERING COMPANY, of 277 Broadway, New York City, has secured the contract for the new switchboard of the Trenton (N. J.) Street Railway Company, consisting of 14 panels. It has also secured a number of orders in New York City, and in order to facilitate its deliveries has taken a store room at 88 Warren Street, where it will carry a complete line of knife switches and panel boards.

THE NORTHERN WIRE & CABLE COMPANY has incorporated with a capital of $300,000 full paid, and will at once erect a plant in Milwaukee for the manufacture of lead-covered telephone, telegraph and power cables and wires. It is now in the market for the factory power equipment. J. B. Adams is general manager, with offices in the Wells Building, Milwaukee.

VERA CRUZ LIGHTING PROJECT.—An electric lighting plant is to be built in Acatlan, State of Vera Cruz, Mexico.

General News.

THE TELEPHONE.

WAYCROSS, GA.—The Bell Telephone Company has bought out the Southern Telephone Company, of Waycross. Several thousand dollars worth of improvements are being made.

PAYETTE, IDA.—The Rocky Mountain Bell Telephone Company has decided to make an extension from this city to the mouth of Big Willow canyon, a distance of twenty-eight miles.

BYRON, ILL.—The Byron Telephone Company has increased its capital to $10,000.

FREEPORT, ILL.—The Stephenson County Telephone Company has changed its headquarters from Chicago to Freeport.

WAUKEGAN, ILL.—The Chicago Telephone Company is preparing plans for a new exchange building in this city to cost $50,000.

HILLSBORO, ILL.—The stockholders of the Mutual Telephone Company, of Hillsboro, have voted to increase the capital stock of the company to $10,000 and to bond the property for half that amount.

RUSHVILLE, ILL.—The Rushville, Pleasant View & Browning Telephone Company has been incorporated with a capital stock of $2,400, the incorporators being M. W. Greer, M. S. Strong and S. R. Carey.

UNIONDALE, IND.—The Uniondale Telephone Company erected by and used almost exclusively by farmers is extending its lines to Zanesville and Markle.

VINCENNES, IND.—The Knox County farmers' telephone companies are being connected with the Vincennes Company and soon the city wires will reach nearly a thousand farmers.

LOOGOOTEE, IND.—The Loogootee Telephone system, damaged by fire recently, has again been put in operation. The system has been greatly improved and connection made with the Home Telephone Company's lines at Washington, Ind.

INDIANAPOLIS, IND.—It is now definitely assured that Indianapolis and Chicago will have independent telephone connection by fall. The independent people are pushing work in Chicago and expect to have their city system in operation by July. They will build lines radiating from that city and will connect with the New Long Distance Company at Lafayette and other points further east.

INDIANAPOLIS, IND.—At the annual meeting of the stockholders of the New Long Distance Telephone Company, the old board of directors was re-elected which in turn organized and re-elected S. P. Sheerin, president; A. F. Ramsey, vice-president; H. B. Sale, secretary, and A. H. Nordyke, treasurer. The report of the secretary for the fiscal year showed $16,602.49 carried to surplus, after the payment of expenses of every kind (including quarterly 1 per cent. dividends) which, added to the $14,085.77 surplus of last year, makes the present total surplus $30,688.26.

SULLIVAN, IND.—A delegate meeting of representatives of all the telephone companies in this county was held here on April 25 at which arrangements were made for unifying and installing a complete county service. A conservative estimate shows that it will give Sullivan direct communication with 12,000 telephones in this and adjacent counties. Under the agreement the local company will operate all telephones in Hamilton Township. The general exchange will be located in Sullivan and the arrangement will give free service with all telephones in Crawford County, Ill., Green, Davies and Clay counties, Ind., and connection with the independent system will give free service in Vigo and Knox counties.

INDIANAPOLIS, IND.—The following new telphone companies have been recently incorporated. The Sulphur Springs Telephone Company, capital stock $7,000, John W. Whitworth, Samuel Allen and others are directors; the Macey Telephone Company, capital stock $2,000, Charles M. Snepp, Thos. Y. Savage and E. B. Sutton are the incorporators; the Mount Lebanon Telephone Company, capital stock $3,000, Emanuel Smith, Wm. Andis, Jr., and George Potts, all of Greenfield, are the incorporators; the Mooresville Telephone Company, of Mooresville, Morgan County, filed amended articles of incorporation and increased its capital stock $12,000. This company will make extensions and install a new switchboard. D. B. Johnson, O. H. Mills and A. S. Wheeler are the officials. The local Union Telephone Company, of Washington County, to establish and operate a telephone system in Washington County. The capital stock is $10,000. T. T. Morris, L. B. Palkwood and Wiley Stewart, of Washington, are the directors.

OSCEOLA, IA.—The Crescent Mutual Telephone Company, of Osceola, has been incorporated with a capital stock of $400.

DES MOINES, IA.—The New Sharon Independent Telephone Company has been incorporated with a capital stock of $24,000.

WASHTA, IA.—The Farmers' & Merchants' Telephone Company, of Washta has increased its capital stock from $3,000 to $5,000.

DAYTON, IA.—The Dayton Telephone Company has decided to expend about $3,000 in the improvement and the expansion of its service.

MUSCATINE, IA.—The Muscatine and Louisa County Telephone Company, of Muscatine, has filed articles of incorporation, capital $25,000. J. H. Letts is president, and D. H. Wilbrook, secretary.

BALTIMORE, MD.—The subscribers' suit against the Maryland Telephone & Telegraph Company has been dismissed by the Circuit Court. An injunction was sought to restrain the company from charging more than was prescribed by the ordinance of July 1, 1896, viz.: $4 per month for business and $3 per month for house service.

LANSING, MICH.—The Macon Telephone Company has been incorporated with a capital stock of $2,000.

BROOKLYN, MICH.—The Brooklyn & South Norvell Telephone Company has filed articles of association.

CAPAC, MICH.—The Capac Telephone & Messenger Company has been incorporated with a capital stock of $15,000.

HOWELL, MICH.—The Livingston County Mutual Telephone Company has increased its capital stock from $10,000 to $50,000.

KALAMAZOO, MICH.—Mr. P. C. Burns, president of the American Telephone Company, of Chicago, it is stated, has purchased 12,000 shares of the stock of the Citizens' Telephone Company, of Kalamazoo, and is thereby the largest single stockholder in that company. The company is now engaged in laying conduits.

HUTCHINSON, MINN.—The Hutchinson Exchange Company has decided to construct a line from this city to Minneapolis.

MADELIA, MINN.—The Madelia Telephone Company has been organized with a capital stock of $3,500. The officers are: President, J. J. Keber; secretary, Charles Sundberg; treasurer, L. M. Olson.

MANKATO, MINN.—The Minnesota Valley Telephone Company intends to extend its lines from Mankato to Sioux Falls, S. D., during the summer. The Twin City Telephone Company expects to build a line from Lyle to the Twin Cities. It is also reported that an independent telephone line is projected from Austin westward to Sioux Falls.

LINCOLN, NEB.—The Hebron Home Telephone Company has filed articles of incorporation. The incorporators are Charles M. McNeill and A. H. Hawes. The capital stock is $25,000.

BEDFORD, NEB.—The Bedford County Telephone Company has increased its capital stock from $5,000 to $20,000. The work of stringing about twenty miles of new line is now in progress between Bedford and Morrison's Cove.

WIMBLEDON, N. D.—Business men of this place recently organized an electric light and telephone company for the purpose of furnishing electric lights to the village and to establish a telephone system throughout the county.

IRONTON, OHIO.—The Ohio Valley Telephone Company has been organized with a capital of $200,000 to consolidate the independent lines between Charleston, W. Va., and Cincinnati. It will enter Cincinnati with a line from Portsmouth and will extend to Lexington, Ky., Lebanon, Ohio, and Wilmington, Ohio.

PITTSBURG, PA.—The Bedford-Fulton Telephone Company has been incorporated with a capital of $5,000. T. A. Holmes is one of the directors.

MEMPHIS, TENN.—It is proposed to erect a telephone line along the St. Francis levee system from New Madrid to Memphis. Chief Engineer H. M. Pharr, of the St. Francis levee board is drawing the plans.

SALT LAKE CITY, UTAH.—The strike of the telephone girls of Butte is over and the girls have been reinstated without prejudice. Manager Murray, of the Rocky Mountain Bell Telephone system, learning that there would be a beligerant demonstration of the strikers at Butte, the eleven girls who were taken from here to replace the strikers were sidetracked by the manager at Dillon. At this juncture a settlement of the strike was reached and the girls have returned. Miss McDermott, whose dismissal as chief operator was the immediate cause of the strike, has resigned and it is stated that there is still considerable dissatisfaction, which may result in another strike, over the manner in which she was treated.

RICHWOOD, WIS.—The Richwood Telephone Company, with a capital of $1,000, has been incorporated by John Thaner, E. Krueg, H. Jouger and Frank Petri.

ELECTRIC LIGHT AND POWER.

NEW WINDSOR, COLO.—The Board of Trustees has granted E. I. Raymond and H. C. Branch a franchise to construct and maintain an electric light and power system in the town of Windsor.

WASHINGTON, D. C.—Local press reports state that the Great Falls Power Company will be ready within a few weeks to let contracts for its plant, which will cost about $2,500,000. Allen L. McDermott, president Washington Railway & Electric Company and other stockholders of this road are reported interested.

LOUISVILLE, GA.—The citizens have voted to issue $20,000 bonds for an electric light plant and water works.

EAST POINT, GA.—Judge R. F. Thompson, of East Point, is on a committee to investigate the price of lights and report to the town.

ATLANTA, GA.—O. H. Sheffield, an electrical engineer of Atlanta, visited Anderson, S. C., recently representing a company proposing to develop 5,000 horse power at Cherokee Falls in Abbeville County, S. C. It is proposed to sell electric power to Anderson and other towns.

ATLANTA, GA.—It is reported that negotiations are now on between the Bull Sluice Electric Company and various manufacturing concerns looking to the establishment of a number of the latter near the big electric plant. It is estimated that nearly half of the power will be thus utilized.

LEWISTON, IDA.—The surveyor of the Crackerjack mine is at work preparing plans for an electric plant, the power for which will be generated on Lake Creek.

REXBURG, IDA.—The Snake River Electric Light & Power Company, Ltd., of Rexburg, has been incorporated with a capital of $100,000, by Jas. H. Wilson, John H. Hendricks and others.

BELVIDERE, ILL.—The citizens have voted to issue $25,000 bonds for a municipal lighting plant.

CENTRALIA, ILL.—The Merchants' Light Company has been organized to construct an electric light plant.

QUINCY, ILL.—The Independent Electric Light & Power Company, which recently secured a franchise, has purchased property, and will soon erect a power house.

SAYBROOK, ILL.—It is proposed to construct an electric light plant to cost about $6,000. Private parties are also talking of putting in a plant. Nothing definite has been decided on.

SPRINGFIELD, ILL.—The plants of the Springfield Gas Company, the Springfield Electric Light, Heat & Power Company, the People's Hot-Water Heating & Electric Company and the Consolidated Railway Company are reported about to be absorbed by an Eastern syndicate, which contemplates extensive improvements.

LOOGOOTEE, IND.—The Town Council has taken steps toward the erection of an electric light and water works.

BLUFFTON, IND.—The Council has awarded to the Olds Construction Company, of Ft. Wayne, the contract for a complete incandescent and street lighting plant for $24,950.

ELKHART, IND.—Owing to increase in its business and the necessity of providing additional space for static and rotary transformers, etc., to receive power from the St. Joseph & Elkhart Power Company, the Elkhart Electric Company, of this city, will shortly make a substantial addition to its present power house.

WABASH, IND.—The Council has received a proposition from the Wabash Electric Light Company whose franchise will expire on July 1 for a renewal of the electric lighting contract for five years. The company proposes to install 100 arc lights at $80 per year each with $70 per year for an additional 25 lights or an average of $78 per year for the 125 lights.

ELKHART, IND.—The St. Joseph & Elkhart Power Company has, during the past week, commenced work on the erection of its transmission line between the cities of South Bend, Elkhart and Mishawaka, and the expectations are that the line work will be finished in about two months. The purpose of this company is to furnish power and light in the above named cities and vicinities from a large water-power plant located about midway between the cities of South Bend and Elkhart.

GUTHRIE CENTER, IA.—Luther L. Pennock, City Clerk, writes that the citizens voted to grant the Guthrie Center Electric Light Company a franchise for an electric light plant.

DULUTH, MINN.—Bids will be received May 11 by the Common Council for $40,000 bonds to be used for extending, improving and enlarging the water and light plant. H. W. Cheadle is City Clerk.

CAPE GIRARDEAU, MO.—The Cape Girardeau Waterworks and Electric Light Company has increased its capital stock from $100,000 to $150,000.

BOZEMAN, MONT.—The county commissioners have been asked for a franchise for an electric lighting and water plant at the town of Belgrade.

POTSDAM, N. Y.—The Municipal Lighting Committee, in a report to the Board of Trustees of this village, find that a municipal lighting plant operated by the water power owned and controlled by the village is feasible and practicable.

LUMBERTON, N. C.—The town of Lumberton has voted for electric lights.

SANFORD, N. C.—The Campbell Electric Light & Power Company, of Sanford, has been purchased by A. F. Spencer, of Ansonia, Conn.

BAKER CITY, ORE.—The management of the White Swan Mines Company, Limited, will establish an electric plant to be run by water power, and by extending the wire line will run all its machinery by electricity.

BAKER CITY, ORE.—The Red Boy Gold Mining Company will push to completion the work commenced last year of installing a large electric power plant and will utilize the waters of Olive Lake. A dam fifty feet high will be constructed and will furnish, it is estimated, 2,000 horse power. This power will be sufficient for the operation of the mines and will also be utilized for an electric railway system.

SHENANDOAH, PA.—The People's Electric Light, Heat & Power Company has been incorporated with a capital of $20,000.

COLUMBIA, TENN.—The Senate has passed the bill authorizing Columbia to issue $25,000 electric light bonds.

SPARTA, TENN.—The Sparta Electric Light and Power Company will put in a day circuit to supply manufacturing houses.

MT. PLEASANT, UTAH.—A local company has secured a franchise for the construction and operation of an electric lighting and power plant.

RICHFIELD, UTAH.—An electric power plant will be installed in Sevier County in the near future, the power for which will be secured from a hydraulic canal near Joseph City, where a fall of seventy feet is available.

ALEXANDRIA, VA.—Fred. Russell has petitioned the City Council for a franchise for an electric light plant.

RANDOLPH, WIS.—Bonds to the amount of $5,000 have been voted for an electric light plant.

MILWAUKEE, WIS.—In his annual message Mayor Rose recommends that bonds to the amount of $250,000 be issued for a municipal electric light plant, in accordance with the wish of the citizens who voted in favor of the project.

FT. STEELE, B. C.—South Dakota capitalists have applied for a water right on the Bull River Falls, where they will establish a large plant which will supply sufficient electric energy for surrounding camps.

ROSSLAND, B. C.—It is reported that the Inland Light & Power Company, of Rossland, incorporated with a capital of $15,000 will construct an electric plant on Wild Horse Creek. K. L. Burnet and J. S. Clute are among the incorporators.

REGINA, N. W. TER.—The City Council has decided to construct a system of water works, electric lighting and drainage. John Galt, of Toronto, Ont., will act as consulting engineer.

THE ELECTRIC RAILWAY.

SAN JOSE, CAL.—George W. Elder, of San Francisco, has secured the contract for the construction of the San Jose, Saratoga & Los Gatos Electric Railway. The road will be 22 miles long.

MOLINE, ILL.—The Moline, East Moline & Watertown Railway Company has been granted a franchise for the extension of its lines through Rock Island County.

LINCOLN, ILL.—The Lincoln Electric Railroad Company has been incorporated, with a capital stock of $6,000. The incorporators are D. H. Harts, E. G. King, A. D. Cadwallader.

VINCENNES, IND.—The Citizens Street Railway Company announces that it will build a new power house this year.

RICHMOND, IND.—The Union Traction Company of Indiana will extend its lines from Anderson to Richmond and ultimately to Cincinnati.

TERRE HAUTE, IND.—The City Council has granted a 30-year franchise to O. E. Adams and H. D. Falls, known as the Brazil Electric Company, for an electric railway.

FT. WAYNE, IND.—The Ft. Wayne & South Western announces that the interest of the McKinley syndicate in the proposed Ft. Wayne & Southern Railway, which was to build from Marion to Huntington has been sold to the Union Traction Company.

SIOUX CITY, IA.—The plans for improving the property of the Sioux City Traction Company have been approved by the directors of the company. In all it is planned to expend about $1,500,000.

COLUMBIA, KY.—The Columbia Interurban Railway Company has been organized here, with $15,000 capital stock subscribed. The officers of the company are Prof. W. K. Azbill, president; Capt. W. W. Bradshaw, vice-president; C. S. Harris, secretary; Judge J. W. Jones, treasurer.

WORCESTER, MASS.—W. H. Tyler, one of the promoters of the Worcester, Sterling & Leominster Street Railway Company is to build the line from Worcester to Leominster for the Worcester Consolidated Street Railway Company.

JERSEY CITY, N. J.—The United States Alternating Current Traction Company, Jersey City, capital $50,000, has been incorporated.

ASBURY PARK, N. J.—It is said that the entire overhead equipment of the Atlantic Coast Electric Railway Company's line between Asbury Park and Pleasure Bay is to be reconstructed.

JAMESTOWN, N. Y.—The Common Council has granted a franchise to the Jamestown & Warren Traction Company.

DUNKIRK, N. Y.—The Buffalo, Dunkirk & Western Railroad Company has applied for a franchise in Silver Creek.

AUBURN, N. Y.—The Syracuse & Auburn Railway Company is preparing to make extensive additions to its plant in Franklin street.

PREBLE, N. Y.—A Mr. Conan, of Syracuse, has applied for a franchise here. Mr. Conan is said to represent a company that plans to build an electric railway to connect Syracuse and Cortland.

OYSTER BAY, N. Y.—The Highway commissioners of Oyster Bay have granted two trolley franchises—one to the South Shore Traction Company and another to Wilkins K. Putnam for a cross island route.

ELLICOTTVILLE, N. Y.—The Ellicottville, Mansfield and East Otto Railroad Company has been incorporated, capital $300,000. Directors: Charles G. Locke, Randolph; Owen S. Lang and T. H. Holmes, East Otto.

GLENS FALLS, N. Y.—The Hudson Valley Railway Company has acquired the property and franchises of the North River Railway Company, which was organized to build an electric railway from Saratoga to Glens Falls. The directors of the North River Company have resigned and have been succeeded by the directors of the Hudson Valley Company, who have elected the following officers: Addison B. Colvin, president; John W. Herbert, vice-president; George A. Holmes, secretary, and Dr. John P. Munn, treasurer.

SARATOGA SPRINGS, N. Y.—The Hudson Valley Railway is building an addition to its Queensbury power station, 40 ft. x 40 ft. The company will install an 850-hp Corliss engine, which will be coupled directly to a 500-kw generator. When the water power station is finished and in operation the company will put its high tension line from Warrensburg to Waterford in operation. The power from the Saratoga extension will be furnished from Warrensburg, Queensbury and Saratoga, and from a transformer station at Wilton.

SALISBURY, N. C.—The Salisbury Street Railway is reported to have been purchased by Boston capitalists, who will complete the line to Spencer.

UNIONTOWN, PA.—The Webster Monessen, Belle Vernon & Fayette City Electric Railway Company recently secured a charter for the extension of its lines from Monessen to Uniontown via Star Junction, Flatwoods, Buena Vista, Juniataville and Oliver. Three hundred thousand dollars in bonds have been deposited with the Fayette Title and Trust Company. S. M. Graham is president of the railway company.

NASHVILLE, TENN.—The plan for merging the Gallatin & Nashville Railway and the Nashville & Columbia Railway Company into the Tennessee Interurban Railway was ratified by the stockholders recently.

CHARLESTON, W. VA.—The Kanawha Water & Light Company is to apply for a franchise to build a street railway in Charleston.

JANESVILLE, WIS.—The Council has granted the Janesville Traction Company a franchise.

CHEYENNE, WYO.—Thomas Carlon, of Denver, representing Indiana capitalists, has applied to the Council for a franchise to construct an electric railway here.

THE AUTOMOBILE.

AUTOMOBILES AT ST. LOUIS FAIR DEDICATION.—Automobile service was conducted during the World's Fair dedication days between King's Highway and the World's Fair grounds by the Interstate Transit Company. A big tent was erected at King's Highway and McPherson Avenue and the company's machinery was moved there temporarily. Twelve or fifteen automobiles, each carrying from 12 to 14 persons were used. Immediately after the close of the dedication exercises the machinery was returned to the company's buildings at Eads Bridge and the service across the bridge, for which the company was organized, was resumed. The company has secured a long term franchise to run its automobiles across the bridge, and has ordered 10 new machines, which are now in transit.

NEW INDUSTRIAL COMPANIES.

THE ARTIFICIAL ABRASIVE COMPANY, of Wilmington, Del., has been incorporated, capital $100,000.

THE BINGHAM TRAMWAY COMPANY has been incorporated in Jersey City to build tramways. The company's capital is $50,000.

THE AMERICAN PLATINUM WORKS, capital $70,000, has been incorporated by Theodore Koch, Charles Engelhard and Lyman E. Warren.

THE FUEL GAS MACHINES COMPANY has been incorporated in Jersey City to manufacture gas plants, pumps, engines, etc. The capital stock is $1,500,000.

THE BROOKLYN AUTOMOBILE COMPANY, of Brooklyn, has been incorporated, capital $25,000. Directors: L. A. Hopkins, S. H. Hunt and L. B. Adams, Brooklyn.

THE MOFFETT ELECTRIC RAILWAY BEARING COMPANY, capital $3,000,000, has been incorporated by Samuel B. Thropp, Jr., John Holran, Jr., and George B. Saddler.

THE JOHNSON ELECTRIC COMPANY, of New York, capital $10,000, has been incorporated. Directors: L. F. Johnson, Chicago; E. R. Hunckel and H. A. Russell, New York.

THE CORTLANDT ELECTRIC CONSTRUCTION COMPANY, New York; capital, $5,000, has been incorporated. Directors: W. J. Berg, W. W. Benjamin and J. S. Lawson, Brooklyn.

THE ELECTRIC AND GAS SECURITIES COMPANY, of Yonkers, capital $200,000, has been incorporated. Directors: E. W. Wheelock, W. C. Dodge and P. F. W. Ruther, New York.

THE METROPOLITAN ALUMINUM MANUFACTURING COMPANY, of New York, has been incorporated with a capital of $25,000. Directors: Harry Baum, Adolph Selikowitz and M. L. Wall, New York.

THE COMMERCIAL MOTOR COMPANY has been incorporated in Jersey City, N. J., for the purpose of manufacturing motors. The capital stock is $250,000, and the incorporators are Geo. D. Gregory, Francis P. Page, Harry G. Derby, Thayre McLaren, A. W. Chamberlain.

THE GENERAL CONSTRUCTION COMPANY, of Ft. Wayne, Ind., has incorporated with $50,000 capital stock. Directors: George W. Beers, S. M. Foster, S. S. Fisher and others. The company proposes to take contracts for the construction of electrical plants and systems including telephone and interurban railroads.

THE LOOMIS-PETTIBONE GAS MACHINE COMPANY, capital $2,000,000, has been incorporated to manufacture machinery for production of gas and electricity. Incorporators: Burdette Loomis, Sr., of Hartford, Conn.; Burdette Loomis, Jr., and Hawley Pettibone, of New Rochelle, N. Y., and Benjamin Guggenheim, of New York City.

THE JONES-HOGUE CONSTRUCTION COMPANY has incorporated at Indianapolis, Ind., to do electrical and mechanical engineering and construction work of railway and power plants. The incorporators are H. W. Jones and George A. Hogue, of Cleveland, O. L. L. Green and E. E. Elliott, of Indianapolis. At present the company will limit its interests to the building and equipping of electric railways.

THE UNITED LIGHT, POWER AND TRACTION COMPANY, of Buffalo, N. Y., has been incorporated to carry on the business of electrical and civil engineers to manufacture electricity for light and heat and power, to construct bridges, buildings, machinery, railroads, tunnels, subways, docks, waterworks, gas works and canals. The capital is $500,000 and the directors are Louis B. Grant, Ashley T. Cole, William J. Bagnell, Charles T. Lark, Richard F. McKiviry and Charles H. Werner, of New York City, and Joseph B. Mayer, of Buffalo.

LEGAL.

SALT LAKE WATER AND ELECTRICAL POWER COMPANY.—An important decree of the district court at Salt Lake City orders the sale of the property and intangible interests of the Salt Lake Water & Electrical Power Company for the satisfaction of judgments against the company aggregating $500,000. A receiver has been appointed and the proceeds of the sale will be divided among lien and bondholders.

TICKER NEWS OWNERSHIP.—The decision of the United States District Court of Milwaukee granting an injunction restraining Hadden, Rodee & Company, a local commission house, from using or acquiring quotations of the Chicago Board of Trade has been confirmed in the United States Circuit Court of Appeals by Judges Grosscup, Jenkins and Baker. The decision is of importance in that it upholds the board's right to maintain an action to protect its quotations, notwithstanding the sale of the right to the telegraph companies to distribute the same.

BULLOCK COMPANY INDUCTION MOTORS.—On Saturday, May 2, 1903, the U. S. Circuit Court for the Southern District of Ohio issued a restraining order against the Bullock Electric Manufacturing Company, of Cincinnati, restraining it from manufacturing or dealing in alternating current polyphase induction motors, which, it is held, are infringements of the Tesla patents of May 1, 1888, now owned by the Westinghouse Electric & Mfg. Company.

A STOCK QUOTATION DECISION.—At Buffalo, N. Y., on April 29, Judge Hazel, in the United States District Court, handed down his decision in the suit brought by the Board of Trade of Chicago against the Consolidated Stock Exchange, of Buffalo, and others. The decision is in favor of the defendants. A motion by the plaintiff for a temporary injunction is denied. The plaintiff wanted a temporary injunction restraining the defendant from using "continuous" market quotations in Buffalo as published on the Exchange floor in Chicago. The basis of the application, according to the decision, was a contract between the complainant and several telegraph companies, and the alleged unlawful use by the defendants of the quoted market prices. The relations established by the contract, the decision states, restrict the publication by the telegraph companies of "continuous quotations" to companies and individuals who are their patrons and subject to certain stipulated contracts.

PERSONAL.

PROF A. G. BELL is the subject of an excellent front page, full-page portrait in the *Scientific American* of May 2.

MR. ANGUS S. HIBBARD, general manager of the Chicago Telephone Company, has been made second vice-president.

MR. HARRY DIXON, of Wickford, R. I., bought recently the commercial electric lighting plant of the Wickford Worsted Mills.

MR. WM. STANLEY, JR., has sailed for Europe, although it is not long since he returned to this country from that part of the world.

DR. THOMAS ADDISON, district manager of the General Electric Company, with headquarters in San Francisco, has returned to that city after visiting New York.

PATTISON BROS., the consulting electrical engineers, New York City, have moved uptown and have taken offices in the famous "Flatiron" Building, at Fifth Avenue and Twenty-third Street.

MR. JOSEPH B. HALL, recently sales representative of the Power & Mining Department, General Electric Co., Chicago, is now chief engineer of the McGuire Manufacturing Co., of the same city.

MR. H. F. HILL will, it is understood, be appointed general manager of the Central Union Telephone Company, as a result of the changes due to and consequent upon the resignation of Pres. John I. Sabin.

MR. T. W. SEAMAN, treasurer of the Westinghouse Electric & Mfg. Company, is a director in the new Gibraltar Trust Company, recently formed in New York with a capital of $500,000 and a surplus of like amount.

MR. T. A. EDISON is reported to be developing for some people interested in the subject a method of dry placer mining, employed devices similar to those worked out in his magnetic ore crushing and cement making processes.

MR. H. L. CANFIELD, who controls the interests of the Delphos, Ohio, Electric Light & Power Company has been granted a 25-year franchise by the City Council for a telephone system, and will install an up-to-date exchange plant.

MR. J. F. STAUFFER.—We regret to learn as we go to press the news of the death of Mr. J. F. Stauffer, president of the Geo. C. Towle Mfg. Co., of Lancaster, Pa., well known as manuafcturers of stationary motors, electric fans, etc.

MR. A. MEYER, president of the Crescent Company, Chicago, sailed on the steamship *Statendam*, April 22, for a European trip, his intention being to introduce the cord adjuster, soldering stick and other specialties made by this company, to the dealers in Europe.

MR. GORDON, of the turbine department of the British Westinghouse Electric & Manufacturing Company's Manchester works, who has been on this side for some weeks past studying the building of turbines at the Westinghouse plants, Pittsburgh, has sailed for home.

MR. B. A. BEHREND, the chief electrical engineer of the Bullock Electric Mfg. Company, of Cincinnati, is the worthy subject of the company's illustrated portrait biographical calendar for May, just issued. He was born in Pomerania in 1875 and left the Oerlikon service in 1899, coming to the United States.

E. P. ROBERTS & CO., consulting engineers, Electric Building, Cleveland, O., announce that owing to the increasing demands of their Eastern business they have opened a branch office at 25 Broad Street, New York City. This office has been placed under the management of William C. Andrews, E. E., Eastern representative of the company, as already announced in these columns.

MR. WILLIAM H. NISBET, of Sidney, N. S. W., formerly superintendent of motive power of the Queensland government railways, who now represents the Westinghouse Air Brake interests in Australia, is at present in this country for the purpose of making arrangements to represent other American concerns seeking business in the Antipodes. Mr. Nisbet is a guest at the Holland House.

MR. T. J. COPE, 3244 N. 15th St., Philadelphia, the well-known contractor and manufacturer of appliances for telephone cable and conduit work, has recently returned from an extended trip through the West, including a number of cities where he is installing cables. Mr. Cope also reports the sale of large quantities of Cope cable racks, and conduit rods on this trip. He finds great activity in the telephone field.

MR. LOUIS T. GRANT, managing engineer of the firm of Michael, Gaspar, Grant & Co., Ltd., Manila, P. I., writes us confirming the news of the recent White, Swift, Westinghouse street railway deal there, as already noted

in these columns. He also states that a new electric light plant has been installed in the city of Iloilo, which is doing well. There are several electric railway projects afoot in the provinces. The city of Manila has a new Gamewell fire and police system just installed and giving good service.

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society last week the following-named gentlemen were elected to membership: N. B. Tretheway, C. G. Young, Jeremiah J. Kennedy, Maurice Hoopes, Percy Foote Cowing, Fred W. Ellen, John B. N. Vanzandt, F. H. Fuller, Fred'k J. Hall, Wm. F. Bissing, Wilson S. Howell, Frederick Arthur Goetze, Joseph W. Tracy, Martin J. Insull, George T. Conkling, Eugene P. Etzel, John D. Keily, Anthony L. Noone, Harry C. Hall, L. F. Bentley and R. R. Hutton.

MR. D. H. ERWING, of Muskegon, Mich., has a franchise for the construction of 3 dams on the Muskegon River between Big Rapids and the Newago County line, two of them 24 feet head and one a 35 foot. Each of these dams will develop at ordinary stages of this river five or six thousand horse power. It is understood that Grand Rapids and Eastern capitalists are behind the project, and that work will be commenced at once on the first dam, and rushed to completion, as the promoters claim to have a ready market in Grand Rapids for the entire output of one dam.

MR. J. B. ORR, the commercial partner resident at Rio de Janeiro of James Mitchell & Company, sailed May 5 for home, after several weeks visit to the United States. Mr. Orr, while here, made arrangements for the extensive importation into Brazil of American cotton making machinery. Hitherto that market has been taken care of exclusively by British manufacturers. The Mitchell firm will handle the looms of the Northrup Loom Company, of Hopedale, Mass. The machinery will be in many instances electrically operated. Mr. Orr also placed orders for several small electric lighting plants to be installed in Rio and vicinity.

BARON VON RHEINHABEN, the Prussian Minister of Finance, has sailed for New York from Bremen on the North German Lloyd steamer *Kaiser Wilhelm der Grosse* to remain six weeks in America, for the purpose of studying the economic conditions of the United States. He will bring with him Commercial Councilman Boeker, an ironmaster of Remscheid, Prussia, and Frederick von Versen, Deputy Consul General of the United States in Berlin. The Baron does not speak English fluently, and von Versen will act as his interpreter. The Baron is especially interested in iron and in railroad and water transportation. He will visit Pittsburg, the electrical works at Niagara, the Erie Canal, the Welland Canal and the Sault Ste. Marie Canal.

MR. T. TAIT, the recently appointed Commissioner of Victorian Government Railways, Australia, left Vancouver, May 1, by the Canadian Pacific steamship *Miawera*, for the purpose of assuming his new position. Mr. Tait is a Canadian and was formerly connected with the Canadian Pacific Railroad. Before sailing he secured considerable data at the request of the Victorian Government, regarding American electric traction methods, etc., as it is proposed to convert electrically the horse and cable car system in Melbourne. The Sydney electric traction system is built and operated by the New South Wales Government under the supervision of the railroad commissioners of that state, and it is anticipated that the Melbourne system will be converted and worked by the Victorian Government under the direction of Mr. Tait and his associates.

BELL TELEPHONE APPOINTMENTS.—The following named gentlemen have been elected vice-presidents of the American Telephone & Telegraph Company: E. J. Hall, vice-president and general manager of the New York Telephone Company; George W. Cumming, formerly vice-president of the Erie Railroad; General Thomas Sherwin, president of the New England Telephone Company; C. J. French, general manager of the American Bell Company. They will retain their respective positions with the sub-companies. L. T. Richardson, solicitor for the Central Union Telephone Company will be elected president, succeeding General Sabin, who returns to take exclusive charge of the Pacific Coast Telephone Company. Arthur D. Wheeler, a director of the Chicago Telephone Company, will be elected president of that company, succeeding General Sabin.

MR. G. MARCONI arrived in Rome recently from London, and a new agreement between him and the Government has been made public. The agreement will include the establishment of a system of twelve stations of the average range of 300 kilometers. All the stations will be ready a year from next July. Two of them are to be an augmentation of those already erected at Punta di Vela and Montemario, and will be exclusively for military use. The others, for both military and commercial use, will be erected at Capo di Leuca, near Gaeta, at Elba, and at Asinara. Under the new agreement Signor Marconi cedes his apparatus to the Government free of charge, but with the following stipulations: Receipts from the coast stations are to be paid in to the National Treasury; receipts from dispatches sent from ships provided with the Marconi apparatus will go to the Marconi Company; moreover, the State will receive a fixed tax of one lira per message above the usual cost of telegrams.

MR. WILLIAM KENT.—We note with pleasure that Mr. William Kent, of New York City, has been selected for the position of Dean of the L. C. Smith College of Applied Sciences of Syracuse University. Mr. Kent is a man of thirty years' practical experience, and occupies a high position in the engineering world. He was born in Philadelphia, March 5, 1851. He was graduated from the Central High School of Philadelphia in 1868, and from the Stevens Institute of Technology in 1876. He married in 1879 Miss Marion W. Smith. Mr. Kent was editor from 1877 to 1879 of the American Manufacturer and Iron World of Pittsburg, after which, until 1890, he held the position of mechanical engineer and superintendent in various iron, steel, and boiler concerns. Since 1890 he has been a consulting engineer, and in 1895 became associate editor of *The Engineering News*. Mr. Kent is a member of the American Institute of Mining Engineers, American Society of Mechanical Engineers and a Fellow of the American Society of Applied Sciences. He is the author of "The Strength of Materials," "Strength of Wrought Iron and Chain Cables," and various works on similar subjects.

Trade Notes.

THE RUSHMORE DYNAMO WORKS have removed their office and works to Plainfield, N. J.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, has shipped a 3,000-light dynamo to the St. Louis Exposition.

"FISH PAPER."—We have an inquiry for "fish paper" or "fish board" for electrical insulating purposes, and shall be glad if any of our readers can inform us where and by whom it is made.

THE AMERICAN TIN PLATE CO. has just sent its 25th order for oil filters to the Burt Mfg. Co., Akron, Ohio, making thirty filters now in use in its works.

SIMPLEX ELECTRICAL COMPANY has moved its Chicago offices to 1144-5-6 Monadnock Block, and its warehouse to the basement, N.W. corner of Dearborn and Harrison Streets, Mr. H. R. Hixon is Western selling agent.

ALLIS-CHALMERS COMPANY, Chicago, announces that after May 1 the general offices of the company in that city will be located in the New York Life Building, corner La Salle and Monroe Streets, on the fourteenth floor.

REFINING METALS.—The New York office of Croselmire & Ackor is now located at 10 East 23rd Street. This company has headquarters in Newark, N. J., where it refines metals, making a specialty of platinum for electrical work.

LAMP FACTORY ON PACIFIC COAST.—The Charles F. Sloane Company has leased two 50x100-foot floors in the new Kahn building in Oakland, Cal., which will be occupied by the company's incandescent lamp factory. About 300 employees will be required at the new plant.

MESSRS. ROSSITER, MACGOVERN & CO., on May 1st moved their offices to the Whitehall Building, Battery Place, New York, where they are occupying about 2,400 feet of space, and where they will be pleased to welcome their friends. Incidentally it may be mentioned that the finest view obtainable of the New York harbor is from the windows of this firm.

YOST ELECTRIC MFG. COMPANY, of Toledo, Ohio, makers of the Yost socket, state that owing to the great number of orders and inquiries from the Eastern territory, they have found it necessary to open an office in New York City, located at 120 Liberty Street, under the management of Mr. George A. Amble.

THE SOUTHWEST ELECTRICAL COMPANY, of San Bernardino, Cal., we are informed by Mr. J. H. Curtis, 482 Third Street, proposes to develop along the line of construction work, installing plants, erecting pole lines, constructing roadbeds and tracks, etc. It does not intend, at least for the present, to go into any line of manufacturing.

THE CENTRAL ELECTRIC COMPANY, of Chicago, reports that so far this spring it has received more orders for Stombaugh guy anchors than ever before. It attributes this to the fact that the Stombaugh is easy to install, is cheap, will stand a great strain, and will give satisfaction in general. A descriptive pamphlet will be sent upon application.

MR. GEORGE T. HANCHETT has removed his office from 116 Nassau Street to the Engineering Building, 114-118 Liberty Street, New York. At this location he is continuing his engineering business, having largely increased his laboratory facilities. Mr. Hanchett's specialty is electrical and mechanical machine design and electrical testing and reports on materials, apparatus and installations.

THE ELECTRIC APPLIANCE CO., Chicago, states that it has served notice on all alternating current electric lighting plants that it has instituted a vigorous campaign against them on the subject of Gutmann watt-meters. If there is an alternating plant in the United States not receiving this meter literature, it is an oversight which the company says will be promptly corrected if notification is sent in.

REMOVAL.—The Mica Insulator Company, Ltd., of Stansted, Essex, England, has removed its works to Blackhorse Lane, Walthamstow, London. The necessity for making this change was occasioned by the increase in the company's business and the desirability of choosing a location more convenient for transportation and prompt deliveries. The new works were specially built to meet the company's requirements.

SPRAGUE GENERATORS.—Bulletins Nos. 101 and 102 of the Sprague Electric Company, New York, relate to direct-current generators of the single field coil type and of the split pole type, respectively. The machines of these two types are very clearly illustrated and the detail views show in a very clear manner the construction of the machines. The two bulletins are gotten up in the company's usual artistic manner.

CHANGE OF FIRM NAME.—The business conducted by Mr. H. E. Maxfield, resident agent for Lawrence centrifugal pumps at 39 Cortlandt Street, New York, has been changed and will now be known under the firm name of H. E. Maxfield & Co., with offices at 136 Liberty Street. All inquiries for centrifugal pumping machinery, house pumps, hoisting engines and general machinery will be given prompt attention.

PHONO-ELECTRIC WIRE.—Large export sales of the Phono-Electric wire of the Bridgeport Brass Company are reported. It has already attained great popularity abroad. Orders have been received from the Dublin United Tramways, Glasgow Corporation Trams, Walsall Corporation Tramways, and many of the large street railway companies of Great Britain are reported to be using it. The sales in the United States are also continuously on the increase.

THE BASSETT-PRESLEY COMPANY, Cleveland, O., dealer in iron and steel supplies of all kinds is preparing to take up the sale of telephone supplies such as bare and insulated wire, cross arms, insulators, bolts, rivets, etc. The company is erecting one of the largest warehouses in the West in which the entire business will be located. The establishment is situated on Clifton

Street, near the Cleveland & Pittsburg Railway, and the building is 360x150 feet of brick and steel and two stories high.

THE EMPIRE WIRE COMPANY, which was organized about one year ago and took over the business of C. M. Garrison, Spargo Wire Works Company, and Empire Insulated Wire Company, all of 100 William Street, New York City, the latter two having factories at Rome, N. Y., has found it necessary to increase its capacity for the manufacture of magnet wire in order to handle its rapidly growing trade. To do this it has taken over the mill of the Granite State Electrical Works, at Lisbon, N. H., which has been thoroughly remodeled and equipped with new modern machinery and placed in charge of a man who has been assistant superintendent for the Empire Wire Company and the Empire Insulated Wire Company for several years. It is now turning out from this mill a wire, the quality of which is equal to that which it has heretofore made at its old factories. To look after the requirements of its western trade, the company has opened an office and stock-room at 60 West Van Buren Street, Chicago, Ill., in charge of Mr. A. D. Forney. On May 1st, the general offices of the company were moved to 92 William Street, New York City.

HARRISBURG ENGINES.—Mr. W. R. Fleming, president and general manager of the Harrisburg Foundry & Machine Works, in a circular letter makes the following very interesting announcement: "The Harrisburg Foundry & Machine Works have received a contract for one of their latest standard compound engines from a source which would seem to reflect even higher credit upon the products of this concern than from almost any other source among their many high class purchasers. This order comes from the United States Government for a model machine to be used in a new bureau created by the Government, to be known as the National Bureau of Standards. In this bureau will be tested and displayed the highest examples of engineering appliances produced in the United States. The Harrisburg engine will be used for driving electric generators to be made by the General Electric Company, and the capacity is about 150-hp. It is not the size of the contract so much that makes this sale remarkable, as it is the fact that Harrisburg machinery was selected by experts employed by the Government to use as an example of the highest art of its kind. It is also interesting to note that the order was received at a price very considerably higher than other makes of machinery for which much was promised, but it did not satisfy the severe requirements made necessary by the Government's purpose in establishing a Bureau of Standards."

SMOKELESS COMBUSTION.—The question of smokeless combustion is always an interesting one to the managers of electrical power stations. The Duluth Stoker Company, Duluth, Minn., manufactures a stoker which possesses many features of interest to engineers. Briefly, it consists of an endless belt of grate bars, the bars lying crosswise in the furnace parallel to each other and are carried by two endless chains, one on each side of the furnace, An independent engine is usually installed to drive each line shaft, and from two to eight stokers may be driven from any one shaft, as circumstances demand. The economy of these stokers is stated to be due, in part, to the fact that the heating surfaces are kept free from soot deposit, rendering them capable of readily absorbing the intense heat generated by the stoker fire. The body of the stoker is composed almost entirely of structural steel and the driving gear is enclosed in an oil-tight and dust-proof casing, insuring easy working and freedom from destructive wear. An illustrated pamphlet describing these stokers has recently been issued by the company, a copy of which may be obtained on application.

ALBERT FRANK & COMPANY, general advertising agents, have removed their offices from the Empire Building to the Broad Exchange Building, 25 Broad Street, New York. This change of location was necessary to obtain more room to transact the steadily increasing volume of business of the company. The new offices occupy a floor space of over 3,000 feet or nearly twice the area of the old ones. They have been fitted up with all of the latest office facilities and improvements that are essential for the rapid dispatch and accurate handling of business. The filing room has received special attention. In it all leading publications of this and foreign countries will be carefully preserved in a systematic manner, so that, at a moment's notice, any copy will be readily obtainable. The new location is in the heart of the financial district. It will be remembered that shortly after the death of Albert Frank, the founder of the agency, the surviving partners, James Rascovar and Collin Armstrong, organized the business as a corporation with the first named as president and the last as treasurer. Since then the company has developed its commercial department extensively, and has increased its facilities for placing advertisements in all parts of the world.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 28, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

726,241. ELECTRICAL COOKING APPARATUS; James I. Ayer, Malden, Mass. App. filed Sept. 10, 1900. The bottom of the cooking utensil has a flange which fits over a circular heating surface and a latch for fastening it in place thereon.

726,269. ELECTRIC TRACK CIRCUIT AND METHOD OF INSULATING SAME; Edward A. Everett, Detroit, Mich. App. filed Feb. 10, 1902. The surface of the ties beneath the rails and the joints between the rails are coated with oil.

726,272. STORAGE BATTERY; Fritz A. Feldkamp, Newark, N. J. App. filed July 8, 1902. The electrode consists of sheets of fabric upon which the active material is spread and thin sheets of lead against the faces of which the fabric is secured by stitching.

726,274. SECONDARY BATTERY; Pietro Figuccia, Boston, Mass. App. filed May 22, 1902. The grid is composed of a series of parallel bars, each having a longitudinal groove in its two opposite faces, containing the active material.

726,292. BURGLAR ALARM SYSTEM; Edwin T. Holmes, New York, N. Y. App. filed July 18, 1900. To insure calling attention to an alarm, a clock work is set in operation which repeats the signal for a considerable period of time.

726,293. EXHAUSTING LAMPS; John W. Howell, Newark, N. J. App. filed Nov. 9, 1897. The method consists in pumping off the air from the bulb, closing the connection between the pump and bulb without the aid of heat, volatilizing the chemical within the bulb to absorb the remaining gases then sealing the bulb.

726,301. ELECTRIC RECORDING SYSTEM; Joseph C. Huss and George W. Schilling, Philadelphia, Pa. App. filed Dec. 18, 1902. A device used as a guard over workmen to show when certain operations were performed and the period of the performance.

726,302. ELECTRICAL CONTROL OF ELEVATORS; John D. Ihlder, Yonkers, N. Y. App. filed April 11, 1902. The arrangement includes the use of controlling circuits of different potentials, each of which controls the other in such manner that control of the car from the stations is prevented after the car has come to rest.

726,303. MOTOR CONTROLLING APPARATUS; John D. Ihlder, Yonkers, N. Y. App. filed May 5, 1902. Apparatus for controlling induction motors consisting of fixed and variable resistances in the three-phase secondary circuit and means for short circuiting the variable resistances without varying the fixed resistances as the motor starts.

726,307. AUTOMATIC CONTROL SYSTEM FOR ELEVATORS; Benjamin N. Jones, East Orange, N. J. App. filed Jan. 13, 1903. In a push button system means are provided to prevent outside interference with the car after it has stopped at its destination and before its passenger has alighted from the car and closed behind him the door of the landing.

726,327. SWITCH REGULATOR; Walter S. Moody, Schenectady, N. Y. App. filed Aug. 21, 1902. A switch having its neutral position between two operative positions and a lock for preventing the movement of the switch into one of the operative positions without first moving it into the other.

726,328. FIXTURE FOR VACUUM TUBE LIGHTING; Daniel M. Moore, Newark, N. J. App. filed April 15, 1898. A socket for the end of the vacuum tube in which the clamps and connections are hidden from view.

726,331. ELECTRIC CUT OUT; Lewis J. Mulvaney, Kingsbridge, N. Y. App. filed Sept. 8, 1902. Details.

726,347. FASTENING FIELD MAGNETS TO SPIDERS; Henry G. Reist, Schenectady, N. Y. App. filed Oct. 18, 1901. The laminated pole piece is clamped to a base plate and the latter clamped to the ring of the spider.

726,360. MICROPHONE OR MICROPHONE-TRANSMITTER FOR ELECTRICAL SOUND TRANSMISSION; Friedrich Wilhelm Senkbeil, Offenbach-on-the-Main, Germany. App. filed Jan. 11, 1902. (See page 800.)

726,361. ELECTRICAL SWITCH LOCK; Christopher A. Shea, Philadelphia, Pa. App. filed Feb. 12, 1902. The train automatically locks the switch mechanism of a railway track.

726,364. ELECTRIC FURNACE; Ernst A. Sjostedt, Sault Ste. Marie, Canada. App. filed Sept. 20, 1901. Details.

726,366. DOOR BELL ATTACHMENT AND BURGLAR ALARM; Elbert Snedeker, Brooklyn, N. Y. App. filed March 26, 1902. By suitable switching devices, the bell can be used either as a door bell or burglar alarm.

726,368. ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, Boston, Mass. App. filed April 4, 1894. A number of receiving circuits are tuned for different frequencies, each therefore responding only to that frequency of a number impressed on the transmitting circuit for which it is tuned.

726,370. SAFETY DEVICE FOR ELECTRIC ELEVATORS; August Sundh, Yonkers, N. Y. App. filed Sept. 12, 1902. The motor armature and the brake are in separate circuits controlled by a single switch.

726,391. MEANS FOR VARYING DELTA-CONNECTED VOLTAGES; Albert H. Armstrong and Jonathan E. Woodbridge, of Schenectady, New York. App. filed April 28, 1903. One or more sections of each secondary of a three-phase transformer is cut in or out.

726,413. TRANSMITTING AND RECEIVING APPARATUS FOR HERTZIAN WAVES; Eugene Ducretet, Paris, France. App. filed Nov. 1, 1901. The number of spirals in a solenoid in the receiving and transmitting circuit is adjustable by means of a sliding contact.

726,445. MEANS FOR CONNECTING MULTIPHASE WINDINGS; Walter S. Moody, Schnectady, N. Y. App. filed Feb. 3, 1902. The connection of multiphase windings in delta in such a manner that varying voltages may be obtained therefrom.

726,468. PROCESS OF FORMING ACCUMULATOR ELECTRODES; Gordon J. Scott, Philadelphia, Pa. App. filed Feb. 28, 1902. Consists in separating the electrodes during the forming operation by a baffle interposed between the electrode in such a manner that it will enable current to pass dirctly from one electrode to the next through the baffle and will permit the electrolyte to pass from one electrode to the other, but compel its passage to be along devious paths.

726,476. ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, Boston, Mass. App. filed April 4, 1894. Combination patent of method patent 726,388 preceding.

726,479. MECHANISM FOR CONTROLLING ELECTRIC CIRCUITS; Geo. A. Tate, Chicago, Ill. App. filed Nov. 29, 1901. A circuit breaker is in a shunt controlled by an indicator in the main circuit.

726,485. INSULATING MATERIAL; Willis R. Whitney, Boston, Mass. App. filed May 24, 1902. Consists of very thin sheets or films of glass cemented together by a flexible binding material.

726,497. CARBON HOLDER FOR ELECTRIC ARC LAMPS; Harry P. Bayley, Chicago, Ill. App. filed Jan. 5, 1903. Details.

726,512. RAILWAY SIGNALING DEVICE; Edwin M. Cutting, Oakland, Cal. App. filed Aug. 19, 1902. A signal disk half of one color and half of another, operated in connection with blinders which cover either part and disclose the other.

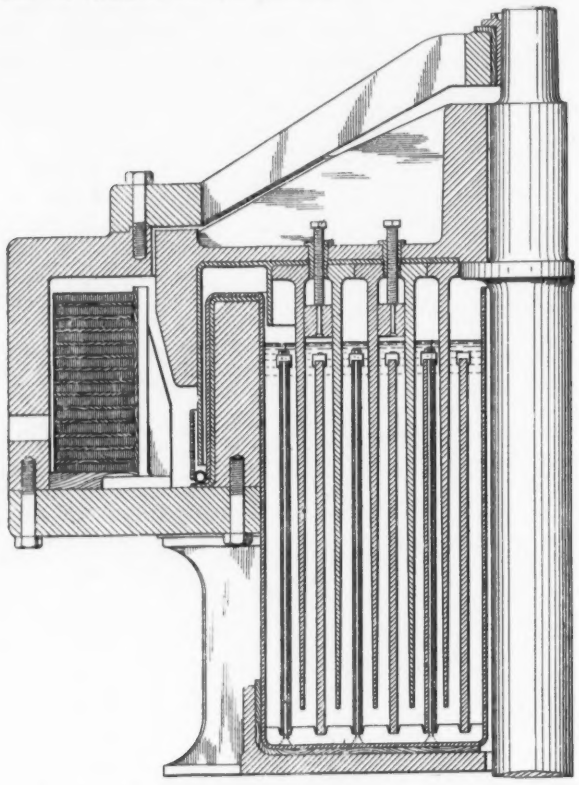
726,536. MECHANISM FOR DRIVING SHAFTS AT VARIABLE SPEED BY MEANS OF ALTERNATING CURRENT MOTORS; Otto Holz, Schnectady, N. Y. App. filed Aug. 15, 1902. A power shaft and a shaft to be driven, with intermediate connecting mechanism comprising two independently rotatable members, a closed winding on one member, a primary winding on the other, a direct current exciter for the primary winding driven by the power shaft and means for connecting one member to the power shaft and the other to the driven shaft.

726,548. CHARGING DEVICE FOR STORAGE BATTERIES; Hermann Lemp, Lynn, Mass. App. filed July 20, 1901. A charging station for electric vehicles comprising a casing containing the current supply devices and having a locked door the key to which is carried by the cabman.

726,566. PRINTING TELEGRAPH SYSTEM; Wm. P. Phelps, Merchantsville, N. J. App. filed March 6, 1902. The auxiliary main line which is used to actuate the press-shifting apparatus in double-type wheel printing systems is also utilized to convey currents from the transmitter to drive a spring winding apparatus by which the type wheels of the printers are rotated.

726,587. TROLLEY WHEEL; Charles S. Stanton, Hartwick, N. Y. App. filed Aug. 20, 1902. Details.

726,593. ELECTRIC CONTROL MECHANISM; Elihu Thomson, Swampscott, Mass. App. filed Oct. 29, 1900. An automatic device for cutting out resistance is connected with a hand controller in such a manner that the latter is locked while the resistance is being cut out and only unlocked after the resistance has been removed.



726,659.—Apparatus for the Generation and Direct Electrolytic Application of Electric Currents.

726,599. THIRD RAIL SUPPORT FOR UNDERRUNNING THIRD RAIL ELECTRIC RAILWAYS; Leonard Wheeler, Wheaton, and John T. Murphy, Chicago, Ill. App. filed Feb. 24, 1903. A screw carried by the supporting bracket bears laterally against the third rail to hold it in its seat.

726,600. RAIL CONTACT SHOE AND SUPPORT THEREFOR; Leonard Wheeler, Wheaton, and John T. Murphy, Chicago, Ill. App. filed Feb. 24, 1903. The shoe is arranged to co-operate with either an over or under contact third rail.

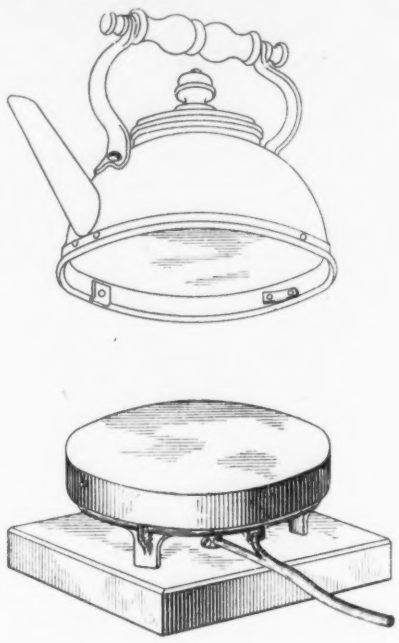
726,605. FUSE BOX; Elmer A. Wilson, Niles, Ohio. App. filed May 13, 1901. Details.

726,651. ELECTRIC WIRE SUPPORT; Beauregard Cullen, New Albany, Ind. App. filed July 14, 1902. Details.

726,659. APPARATUS FOR THE GENERATION AND DIRECT ELECTROLYTIC APPLICATION OF ELECTRIC CURRENTS; Francis E. Elmore, London, England. App. filed Jan. 10, 1902. An electrolytic cell is built into the same structure with a unipolar dynamo, the armature of the latter being directly connected with the electrodes of the cell.

726,687. MAGNETO; Chas. W. Holtzer, Brookline, Mass. App. filed Feb. 26, 1903. Details.

726,693. TELEGRAPH SYSTEM; Charles K. Jones, Tuscumbia, Ala. App. filed May 24, 1902. An alarm is sounded at a local station in the event of the main line being left open.



726,241.—Electric Cooking Apparatus.

726,704. RECTAL OR VAGINAL SPECULUM; Otto H. Kohlhass, Calumet, Mich. App. filed Dec. 29, 1902. An instrument by which cautery and other operations can be performed in the rectal or vaginal passages.

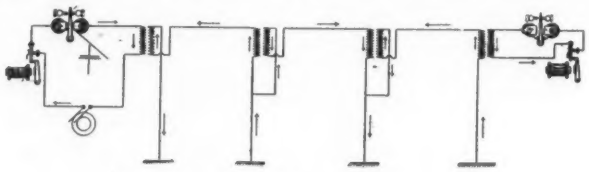
726,721. THIRD RAIL GUARD FOR ELECTRIC RAILWAYS; Jacob Martin, New York, N. Y. App. filed Jan. 23, 1903. A flexible cover over the third rail is opened by a plow as the car moves along to admit the collecting device.

726,725. SYNCHRONOUS CODE TELEGRAPHY; Edwin F. Northrup, Philadelphia, Pa. App. filed Oct. 10, 1902. Consists in sustaining upon a circuit a succession of periodic impulses and forming the characters of a Morse code by changing the phase of a number of impulses for each element the characters of the code being independent of a preselected number of impulses, but dependent upon the relation between the number of impulses modified to form one element and those modified to form another element.

726,734. ELECTRIC CIRCUIT; Edwin F. Northrup, Baltimore, Md. App. filed Sept. 27, 1901. To protect the terminal instruments of a telegraph circuit from disturbance from foreign or induced currents the line is divided into sections in each of which at a given instant the current flows in the opposite direction to that in an adjacent section and neutralizes the inductive effects of one section upon another.

726,736. SYNCHRONOUS CODE TELEGRAPHY; Edwin F. Northrup, Philadelphia, Pa. App. filed Oct. 10, 1902. Apparatus for carrying out the preceding method.

726,750. MEANS FOR PRODUCING SYNCHRONOUS MOTION; Louis M. Potts, Baltimore, Md. App. filed Dec. 10, 1901. Maintaining synchronism by closing and opening at definite intervals a shunt circuit of



726,734.—Electric Circuit.

resistance, capacity or self-induction, around the motor armature or around a resistance in series therewith.

726,831. METHOD OF CONNECTING MULTIPHASE WINDINGS; Walter S. Moody, Schenectady, N. Y. App. filed Feb. 3, 1902. The method corresponding to the apparatus covered in patent 726,445.

726,832. LOCKING DEVICE; Charles F. Ritchel, Bridgeport, Conn. App. filed Oct. 13, 1902. A device for fastening metallic parts to porcelain bases.

726,835. TELEPHONIC APPARATUS; Frank W. Wood, Newport News, Va. App. filed Aug. 1, 1902. (See page 800.)

726,836. TELEPHONIC APPARATUS; Frank W. Wood, Newport News, Va. App. filed Aug. 7, 1902. (See page 800.)